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VOL. IV

EGGER TO GLASTONBURY

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WITH ATLAS & GAZETTEER INDEX*



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EGG to GLA

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GREEK SCULPTURE TYPE

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THE HALLS OF THE BRITISH MUSEUM

PRONUNCIATION

THE imitated pronunciations are intended to assist the reader in the enunciation of unfamiliar words, and necessarily, especially in the case of foreign words, only afford a rough approximation to the actual sound. The signs used are to be pronounced as follows —

a	..	as a in hat	o	..	as o in not
ah	.	„ a in father	ō	..	„ o in note
ā	.	„ a in hate	u	..	„ u in but
ār	..	„ ar in hare	ū	..	„ u in tune
aw	..	„ o in more	ur	..	„ ur in lure
e	.	„ e in bell	oo	..	„ u in put
ē	..	„ e in bee	ōō	..	„ oo in boon
ēr	..	„ eer in deer	ou	..	„ ow in now
e	..	{ e in herd, or	ŭ	..	„ a in comma
		{ i in bird	th	..	„ th in think
i	..	„ i in bit	dh	..	„ th in there
ī	..	„ i in bite	gh	..	„ ch in loch
īr		„ i in fire	zh	.	„ s in pleasure

Other consonants are given their ordinary English sound

Egger or **Eggar Moths**, a name for several species of *Lasioampine* moths of considerable size of which the oak egger is the best known. The male is brown with a yellow band across the wings the female being larger and paler. The males can scent the females at a great distance and collectors commonly secure large numbers of them by attracting them to a female put in a box with a mushin top. The larva which feeds largely on the white thorn is hairy and tufted and when pupating spins a silk cocoon as large as a sparrow's egg.

Egg Oil, a fatty oil obtained from the yolks of eggs. The oil is of the semi-drying kind and is employed to a considerable extent in leather dressing. In practice it is usual to employ the entire egg yolk and not to separate the oil from it. Egg oil is rich in lecithin and cholesterol.

Eggs The best laying breeds of fowl are the Ancona Andalusian Leghorn Minorca Red-cap Rhode Island Red Scots Grey and White Wyandotte which all lay white eggs of good size and shape. The White Sussex is another good layer. A fowl's egg should be oval of uniform colour clean unsteamed and unwrinkled shell rich golden-coloured yolk which keeps its shape when the egg is poured out with no spots but a germinal disc and the white fresh sweet clear and viscous with two layers of different consistency. An egg hatches in gentle warmth over a period. It is one of the most compact forms of human food. It belongs to the body building group of foods about one-eighth of its composition consisting of first class animal proteins. It contains also the vitamins A B1 B2 and D (see VITAMINS) and the mineral salts (qv) phosphorus iron and calcium. The absence of the substances called prime bodies which are found in most protein food and give rise to murex acid make eggs of especial value in the dietetic treatment of gout. The uncooked white of egg causes diarrhoea in some people.

So-called egg powders sometimes consist of baking powder with some yellow substance added. To test mix with a little cold water and heat. Dried egg powder will coagulate or curdle whereas baking powder will effervesce.

Digestibility Though the normal person can digest eggs almost completely the rate of digestion is quicker when they are soft boiled than hard.

Cooking To boil an egg it is best to place it in boiling water for a varying number of minutes according to the consistency required.

Time (minutes)	Consistency
2	White coagulated yolk soft
4	White coagulated yolk solid
10	White solid yolk hard

Soft boiling or coddling is a more pleasant method of cooking eggs in the shell the white being soft though solid and the yolk fluid. The rate of digestion of eggs treated in this way is quicker than by the usual boiling method making them especially suitable for invalids or people with weak digestions.

Eggs should be covered in boiling water and the saucepan allowed to remain in a hot place such as the back of a range and left for 8-10 minutes or for a hard boiled egg 40-45 minutes.

Poaching Eggs should be shelled and placed in boiling salted water to which a little vinegar has been added. The water should be kept hot though not boiling until white is firm.

Frying Place contents of egg in hot lard dripping or bacon fat keep over a gentle heat pouring the fat over the egg with a spoon. The edges of the egg should not become brown and leathery.

Scrambling Allow 1 tablespoonful of milk and $\frac{1}{2}$ oz of butter to each egg. Melt butter in saucepan add beaten egg and milk. Stir over a gentle heat until creamy and pour over buttered toast.

Various *R. types* with hard boiled eggs may be served as savouries or supper dishes e.g.

Scotch Eggs

2 hard-boiled eggs

2 sausages

Egg and breadcrumbs to coat

Enclose each egg in sausage meat
Coat with egg and breadcrumbs and
fry in deep fat Drain, cut in half,
and serve

Egg Preservation (see also CATTING)

To preserve eggs, the small holes in the shells must be closed to prevent air from gaining access to the interior. This may be done with sawdust, salt, paraffin, lard, oil, dripping, bone-water, water-glass or a commercial preparation consisting of fat in solution.

Preservation in Water-glass

1 Obtain fresh eggs, preferably infertile

2 Make water-glass solution with boiled water. The proportion of water-glass to water is about 1 to 9 but directions are usually given on the tin (10 dozen eggs require about 10 pints solution)

3 Wipe eggs with clean, dry cloth put in galvanised-iron pail, glazed earthenware crock, etc

4 Pour cold water-glass solution over eggs. It should cover them by 3-4 in

5 Cover with lid or board

6 If liquid evaporates, add some more cold dilute solution

These eggs can be used for all purposes except meringues and soufflés. The white tends to become thin on keeping, and cannot be whipped stiffly. Before boiling, prick the shell to prevent it from cracking.

Eggs, Industrial Handling of. Eggs are best consumed new-laid, and there is no reason why all the eggs secured in Gt Britain should not be produced in Gt Britain instead of nearly 3,000,000,000 being imported in a year. The best method of keeping eggs is cold storage at a temperature slightly below freezing-point, but if kept too long the quality deteriorates. When used by bakers and other food manufac-

turers, the eggs are frequently examined by transmitted light, a process sometimes called *candling*. The expert can in this way judge the quality of the egg by the appearance of the yolk, and the presence or absence of dark spots. After breaking, the eggs are mixed mechanically and frozen in tin cans.

A fresh egg is germ-free, but bacteria can gain access to its contents through its porous shell. Porosity may be defeated by water-glass, and preservation in a solution of this is one of the commonest methods adopted. The Chinese preserve eggs for food by coating them thickly with rice paste and burying them in the ground for long periods of years. Putrefaction does not take place, the flavour of the egg is pleasant and delicate, but the white coagulates to a brown transparent jelly, while the yolk assumes an olive-green colour. These eggs are eaten uncooked.

Desiccated eggs are made by drying the mixed yolk and white very rapidly as a film or spray. The resulting powder keeps fairly well, and when mixed with water regains its original qualities to some extent. Such eggs are largely used for cake-making and similar purposes. *Egg substitutes*, egg powders, and similar preparations generally consist of milk casein or blood albumin mixed with starch, though many of them consist of pure starch flavoured and coloured.

Egin [A'GIN], town in Turkey on the Upper Euphrates, 140 m SSW of Trebizond. It was colonised by Armenians during the 11th cent. At the close of the 19th cent some terrible massacres of Armenian Christians occurred in the town. Pop 23,000.

Eglantine, name given variously to rose, honeysuckle, or woodbine.

Egmont, Lamoral, Count of, Prince of Cávre (1522-1568), served under the emperor Charles V in Algiers, and in 1554 came as Ambassador to England to arrange the marriage between Mary Tudor and Philip II of Spain. He led the Flemish to victory against the French at St Quentin in 1557, and

at Gravelines and became Stadtholder of the Netherlands for Philip II. He supported the Protestant Netherlands against Philip absolutely in 1561 and in 1567 was arrested by the Duke of Alba and beheaded (1569) for treason.

Egret, a white heron (*q.v.*) found in both hemispheres and represented by several species. These birds are famous for the beautiful plumes known in the trade as egrette or osprey which before the passing of the Plumage Act were coveted ornaments for ladies' hats in this country. Great cruelties were often perpetrated by the collectors of these plumes and since the birds only acquire them when breeding they were slaughtered wholesale at the season most important for the survival of the species.

Egypt (ancient name *Misr*) a kingdom in N.E. Africa bounded on the N by the Mediterranean on the S by Anglo-Egyptian Sudan on the W by Libya and on the E by the Red Sea. In the N.E. the Sinai Peninsula formed by two arms of the Red Sea separates the country from Palestine. The N.W. arm known as the Gulf of Suez is artificially connected by the Suez Canal with the Mediterranean.

Relief. Nearly 1000 m. of the lower Nile (*q.v.*) lie in Egypt. The deltaic fan is an alluvial plain and S. of this the river follows a well marked trench in the N.E. African plateau flanked by bluffs rising to 1000 ft. in places. S. Egypt is granitic and mountainous; the middle region is a limestone plateau deeply intersected by intermittent water courses or wadis. There is a lofty range in the E. deserts culminating in the Sinai range. The W. deserts include a number of oases.

Climate. The delta has some winter rain and its summer temperature is not unduly high. The desert regions of the S. are intensely hot in summer and rainless; dust storms are a feature of the hot season. In winter when the heat is mitigated Egypt S. of the delta is a favourite health resort for Europeans. Vegetation is scanty save

near water. Date-palms are common and Mediterranean and sub-tropical fruits grow in regions favoured by water. The only fertile parts of Egypt are the area on both sides of the Nile which is subject to annual flooding and controlled by irrigation and the Nile delta comprising lower Egypt. There are also numerous oases in the Libyan desert.

Production. The chief productions of Egypt are agricultural. Situated in a desert region the wealth of the country is almost entirely dependent upon the irrigation system that distributes the vast water supplies of the Nile through the adjacent districts. Egypt owes much to British administration and engineering for improvements in irrigation. The dam at Aswân (storing 400 000 cu metres) and the series of barrages at Assût, Esna, Nag Hammadi and Zifta have added considerably to the cultivable area. The principal crops are cotton, wheat, barley and other cereals, vegetables, sugar-cane and tobacco. Agricultural production is to a very great extent in the hands of peasant proprietors holding c. 50 acres a head. At flood time the peasantry can be compelled to guard the river defences but the old system of forced labour has been superseded for all other purposes. The native textile industries, especially cottons and silks, have progressed in recent years. Fishing is an important subsidiary industry.

Minerals. The chief minerals of Egypt are of increasing importance but have not been fully exploited. The following are worked and exported: manganese, iron ores, phosphate rock, petroleum shale, numerous crystallised compounds of sodium, magnesium and calcium salt and sodium nitrate, talc and various ochres. Alum, sulphur, copper ore and various gems are mined.

Commerce. Great Britain is Egypt's best customer and in return Egypt imports more from Britain than from any other nation. The unit of currency is the gold pound of 100

piastres = £1 0s 6 25d sterling at par

Population Over 60 per cent of the Egyptians are peasantry (fellahin). But now that commerce and industry have been freed from the repressive regulations of the Caisse de la Dette (see section FINANCE), its growth has been reflected in a rapid increase in the urban population. Only c 3½ per cent of the total area supports a settled population, and there is still a considerable number of Bedouins. The resident foreign population is considerable, and consists mainly of Greeks (settled chiefly in Alexandria), British, French, Italians, Levantines, and Jews. The chief towns are Cairo (1,064,800), Alexandria (573,100), Port Said (104,800), Tanta (90,000), Mansûra (63,700), Asyût (57,100), Faiyûm (52,900), Zagazig (152,800), and Damanhûr (51,700). The total pop is 14,217,900.

Religion Of the above, over 30 per cent are Mohammedans of the Sunnite sect. The greater part of the non-Mohammedan native element are Coptic Christians (see CORRS) and are regarded as the only surviving descendants of the Ancient Egyptians.

Communications Cairo is the nodal point of the Egyptian railway system, from the capital lines run to the Nile delta, the Suez Canal zone, and the Red Sea ports. A line runs S beside the Nile for over 550 m to Shellal, where steamer connection links up with the Sudan system. A coastal line W from Alexandria is as yet incomplete, but it is hoped to open up direct communication with Tripoli. A line crosses the Sinai Peninsula to Palestine. There are c 3400 m of State-owned railways open, and 870 m of private lines. In spite of rail developments, the ancient caravan routes traversing the deserts are still of importance. There are weekly air services to Europe, India, and S Africa.

Government In 1930 Egypt was proclaimed a sovereign State governed by a king through ministers responsible to Parliament. Islam is the State

religion. Freedom of conscience, and civil and political liberty before the law are assured to all Egyptian citizens. Legislation is promulgated by the King with the assent of Parliament, initiative being left to the King on certain matters of finance.

Parliament consists of a Senate of 100 members (60 nominated by the king, 40 elected) and of a Chamber of 150 members.

Finance For 70 years the Egyptian Government has been greatly dependent on imported capital, and the new State has recognised the obligations contracted by its predecessors. The foreign creditors of the Government are organised in a body known as the Caisse de la Dette. Restrictions imposed by this body during the period of financial instability have been lifted. The Caisse now receives the revenue necessary to meet interest charges and manages the reserve fund, whose earnings are applied to the reduction of charges on the Treasury.

Education The great University of El Azhar at Cairo (founded A.D. 972) is the metropolis of Moslem learning, under the authority of its governing body are a number of centres of higher education in the chief Egyptian towns. Some progress has been made in the provision of State-aided education. A State university was founded in 1925, and there are a number of State technical and higher educational colleges, such of the very ancient village schools as can produce evidence of efficiency receive a grant.

History The history of Ancient Egypt is of unique interest from its relationship to the events recorded in the Old Testament. No other country can show so long a record of enduring civilisation, and an important school of modern ethnologists holds that all human civilisation originated in Egypt. When towards the close of the 4th millennium B.C. Egypt appears as a united kingdom, the Nile valley had long been the home of a thriving culture, a distinctive Egyptian

EGYPTIAN ART



head
from a
Theban
temple



alabaster
statue



detail from
a bas-relief



wooden
statue



terra cotta
elephant



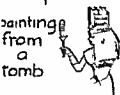
bronze cat



enamel
tablet



early
statue



painting
from
a
tomb



a sphinx



mural painting



detail from papyrus



drawing
from
a tomb

civilisation persisted until at least the 2nd cent A D. The early dwellers in the Nile valley seem to have derived from diverse sources, from Libya and the "horn" of Africa. About 5000 B C three separate kingdoms co-existed and c 3700 B C a fourth arose, centred round Abydos in Upper Egypt. The founder of the 1st Dynasty (4400, 4000, or 3315 B C ?) was Menes. In spite of internal difficulties and external dangers from the Sudan and Libya, Egypt flourished under her



native rulers till the great Semitic invasion which founded the dynasty of the Shepherd Kings (q v) in 1857 B C. The overthrow of these alien rulers is thought by some to have resulted in the Hebrew captivity narrated in Exodus. Under the native rulers a great empire was built up, reaching by the middle of the 15th cent B C to the confines of Assyria and Babylonia, whilst the Sudan was subdued as far as the Fourth Cataract. But the age of security and power passed. Beset by youthful and rising States, Egypt crumbled. Under the mystic, Akhnaton (1370-1354 B C), the Asiatic possessions were lost, until, after having submitted to a Libyan dynasty (the Twenty-second), the kingdom of the Nile ultimately passed under Negro rule in 711 B C. Before her final absorption in the Roman Empire (c 31 B C), Egypt came suc-

cessively under Assyrian, Persian, and Macedonian rule. See also CRUSADES.

Modern Egypt In the year A D 640 Roman Egypt was conquered by the Arab Mohammedans, since when Islam has been the prevailing religion. After the Turkish conquest (1517) the country became a pashalik of the Ottoman empire, and suffered from the administrative evils that beset most of Turkey's dependencies. Egypt, nominally ruled by a viceroy, became the prey of the Turkish military caste or Beys. Financial administration was synonymous with organised pillage of the natives. In the early 18th cent the Mameluke Beys, or bodyguard troops, became rulers of the country. But so cruelly did the general population suffer under this régime, that Napoleon's invasion (1798) was actually welcomed by the down-trodden population. It was not until Mehemet Ali gained control of the Government (1805-11) that Egypt enjoyed settled conditions. He ruthlessly massacred the Mamelukes (1811), and further enhanced his reputation by repulsing a British expedition (1807). He built a fleet and westernised his army. During the early 19th cent he played an important part in European policy in the Near East (see WAR or GREEK INDEPENDENCE), but after 1841 his fleet was dismantled and his power restricted, by European intervention, to Egypt. The pashalik became hereditary in his family. Under his successors, such ambitious schemes as that of the Suez Canal attracted European investors. The country's financial disorder was such that in 1876 the Caisse de la Dette was appointed (see FINANCE above), 3 years later Britain and France took over the administration (the "dual control"). After the nationalist revolt (1882) Britain continued the work of reorganisation alone (see also EGYPTIAN AND SUDANESE WARS). Among the outstanding figures in the new régime were Sir Evelyn Baring (Lord Cromer), who directed the civil administration until 1907.

and Sir Evelyn Wood who reorganised the Army. Sir Eldon Gorst (1907-11) continued Cromer's work; he was followed by Lord Kitchener (1911-14). At the outbreak of the World War the reigning Khedive who was hostile to the Allies was deposed; a British Protectorate was proclaimed and Hussein Kamel became King, followed by Fuad as King in 1917. With the growth of prosperity under a settled admini-

stration King Fuad ultimately dissolved the Wafdist Ministry and Parliament in 1928. This was followed by a general election in which the Wafdists were defeated and the establishment of a régime which is virtually a cabinet dictatorship under the King himself. Great Britain continued to be represented in Egypt by a High Commissioner. A treaty between Britain and Egypt was discussed but no agreement had been reached up to 1933.



Rose Ri th. Herta Egypt

stration the Egyptian nationalist movement gained strength and the late years of Britain's tutelage were marred by violent opposition and continual friction culminating in a demand for independence by the Wafdist (Nationalist) Party. The British Protectorate was at length withdrawn in 1922. The retention of control over the Canal defences and garrisons in strategic places and over Sudan by Great Britain was the cause of further political Wafdist violence.

CONSULT Sir W. M. Flinders Petrie *A History of Egypt* (3 vols.)
The Camels of Ancient History
 J. H. Breasted *A History of Egypt*
 The Earl of Cromer *Modern Egypt*
 (2 vols.) *Annual Statement of Foreign Trade of Egypt* (Official Publications)

Egyptian and Sudanese Wars. The financial difficulties of Egypt led in the seventies to a Franco-British control of finance in the interests of the holders of Egyptian bonds. Resentment at this foreign interference pro-

duced a native rising, led by Arabi Pasha. Alexandria was shelled by the British fleet (1882), and at the battle of Tel-el-Kebir Arabi Pasha was defeated and captured. The consequence of this was the ending of the dual control of Egypt, sole responsibility resting with England.

In 1881 in the Sudan, a territory subject to the Khedive of Egypt, a religious revolt arose against Egyptian rule, the English force was defeated

ing an Egyptian army capable of invading the Sudan. In 1896 the moment seemed opportune for advance, and the Egyptian Army, under the command of General Kitchener, regained the province of Dongola. The advance continued in 1897, being marked by the construction of a railway line across the Nubian Desert. In 1898, at the battle of Omdurman, the rebel forces were decisively beaten, and the Sudan was recovered for



The Pyramids Looking across the River Nile

A British expedition sent to guard the Red Sea suffered reverses at the hands of the Mahdists, as the rebels were called. General Gordon, sent to report on the situation, was besieged at Khartoum and killed in 1885, before relief could reach him. The task of subduing the rebels had failed, and the Sudan was temporarily abandoned.

From 1885 to 1896 the military operations were confined in the main to defending Egypt proper against the attacks of the Sudanese, and to train-

ing an Egyptian army capable of invading the Sudan. The remaining part of the campaign was occupied with the reduction of the country and the defeat of small isolated rebel armies, which was not completed until 1900.

Egyptian Architecture is the parent of architecture. The 1st Dynasty is variously dated at 4400, 4000, or 3315 B.C. Many pre-dynastic remains have been discovered, among them *mastabas*, or covered tombs, whose walls have the characteristic slope or batter which became universal. The walls of the

tomb-chambers of the early dynastic mastabas were decorated with pictorial carvings and hieroglyphics. There are various representations of early structures with wooden posts or tent poles prototypes of the stone column. Papyrus blossom lotus bud and palm leaf capitals are indicated. The lower ends of the shafts are decorated with a wrapping of triangular leaves. The fluted stone columns of the 3rd Dynasty anticipate the Greek Doric.

In the 3rd Dynasty the mastaba developed into the stepped Pyramid of Sakkara. The core is surrounded by a series of graduated walls of successively diminishing heights forming steps. The first true pyramid is that at Meidum contemporary with Sakkara. This also was stepped but it was covered with a continuous casing. In the 4th Dynasty (c. 2500 B.C.) was built the Great Pyramid at Giza and several others as well as the Sphinx. These pyramids stood in an enclosure containing temples mastabas etc. Obelisks monoliths up to 100 ft in height stood in pairs at the entrances to shrines.

Typical of rock-cut work are the temples built by Rameses II (c. 1250 B.C.) at Abu Simbel on the Upper Nile with their colossal seated figures. The great detached temples of the New Kingdom (1600-1000 B.C.) exemplify the highest development of monumental Egyptian architecture. They were approached by an avenue lined with sphinxes leading to the outer gateway. This gave on an outer court often colonnaded. An inner gateway opened into a series of halls forming the temple proper. The hypostyle hall at Karnak with its 134 columns and its higher central avenue providing a clerestory is an outstanding architectural achievement. Almost equally impressive is the 19th Dynasty temple at Abydos. The Ptolemaic temples at Edfu and Dendera are well preserved. The decoration was an ingenious combination of sculpture and painting. The post-and-lintel method of construction is almost universal as

the arch though known was used only for unimportant and often subterranean work.

Egyptian Language The language of modern Egypt is Arabic (q1) but ancient Egyptian was a Hamitic language (q2) which survived until the close of the 16th cent. A. Coptic (q3).

Ehrenbreitstein town and fortress on the Rhine opposite Coblenz Prussia. The fortress is set on a precipitous rock. Its defences from the 12th to the 17th cents. were strengthened by successive archbishops one of whom in 1631 surrendered it to the French. It was recovered (1636) and given to the Archbishop Elector of Cologne. Pop. 3100.

Ehrlich, Paul (1854-1915) German Jewish scientist who after 600 experiments produced salvarsan or 606 a cure for syphilis. This consists of a dye-stuff and an arsenical poison which kills the *Spirochaeta pallida* the germ of the disease. In its colloidal solution arsenic may be introduced into the body in doses that would kill not the parasite but the host if administered in any other way. After further experiments he produced an improved solution called 914 or neo-salvarsan.

Elechhorn (pron. Ichuorn) Hermann von (1848-1918) German soldier. He served in the Franco-Prussian War 1870-1 winning the Iron Cross and gained command of the 10th Army on the L. Prussian front under Hindenburg in 1914. By his capture of Kovno in 1918 he forced the Russians to retreat from Poland. Elechhorn became field marshal in command of the Ukraine after Russia's collapse but was assassinated by the revolutionaries at Kiev in July 1918.

Eider (I dər) river in the Prussian province of Schleswig-Holstein rising S. of Kiel and flowing N.E. to Tönning on the North Sea. It is mostly shallow and sluggish. The 18th cent. Eider Canal was converted (1887-95) into the famous Kiel Canal. The Eider was constituted the N. limit of the Empire in 107 a fact

regards liquids and gases enclosed in vessels, any force that produces a diminution of volume, such as that applied to a piston (Fig 1), is transmitted throughout the liquid or gas so that it is pressed upon equally from all sides

The fundamental type of force producing change of shape is called a *shear*, and consists in applying to a small element of the body two equal and opposite forces acting parallel to one another and a short distance apart

Liquids and gases do not resist shearing stress, since slipping occurs no matter how small the force acting. The measure of the strain produced by a shearing stress is the relative motion of two planes unit distance apart (Fig 2).

The modulus of elasticity of volume is often called the bulk modulus. The reciprocal of this is called the *coefficient of compressibility*.

Gases are readily compressible, but liquids can be compressed only with difficulty. The modulus of elastic resistance to shear is called the *shear modulus*, or often *simple rigidity*. It is determined in its simplest form when a cylinder, fixed at one end, is twisted at the other by a pair of equal and opposite forces. If we imagine the cylinder divided up into a number of tiny cubes, each of these is twisted by the pair of forces, as shown in Fig 3.

An important practical measure of

elasticity is Young's modulus, determined by applying tension to a uniform wire or rod. The stress is measured by the load per unit area, and the strain by the ratio of the increase in length to the original length.

Young's modulus being the stress divided by the strain. This is not related in a simple way to the fundamental bulk and shear moduli.

Young's modulus is important because it applies not only to the stretching but also to the bending or flexure of a bar. If a bar or rod be supported at both ends horizontally, and be loaded with a weight in the middle, the upper half is put under compression and the lower half under tension, the bending produced being easily calculable. The formula for this important example gives the depression produced in a bar of length l , breadth b , and depth d , loaded with a force F in the middle, to be $F l^3 / 4 M b d^3$, M being Young's modulus. When the length of the bar is measured in feet,

the section in inches and the force in pounds, Young's modulus varies for woods of different kinds from $c. 1,000,000$ to over $2,000,000$, and for metals from $c. 10,000,000$ to $30,000,000$ and more.

No substance will react elastically to unlimited shear stress, at a certain

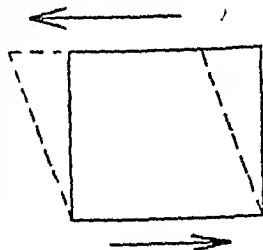


FIG 2

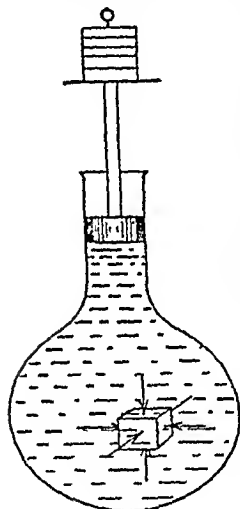


FIG 1

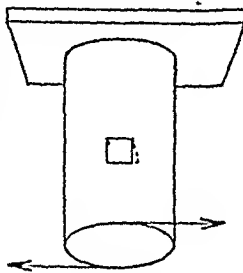


FIG 3

point the molecules of a solid are permanently displaced relative to one another. The first effect of over strain is that the body fails to regain exactly its former shape immediately, indeed a temporary set is produced in most substances by quite low degrees of strain recovery to the original form taking place only slowly. This is called an *elastic after effect*. Another phenomenon is what is called the *fatigue of elasticity*. If a heavy disc for instance be hung up on a wire and given a twist it will oscillate owing to the elasticity of the wire. Apart from the resistance of the air a certain amount of energy is dissipated in the wire itself the amount increasing the longer the oscillations continue.

When a wire is still further strained a stage is reached in which it yields continuously to the force. This is called the *yield point*. Hard substances break before contracting perceptibly.

The elasticity of metals is greatly increased as a result of cold working that is to say the production of wire sheet, and other forms by drawing, rolling, hammering and otherwise working the material cold. The effects of this cold working are removed by heating (*annealing*) when the metal regains its original properties by molecular rearrangement.

Elba, island off the coast of Tuscany, in the Mediterranean belonging to Italy. By a treaty between the Allied Powers and Napoleon (qv) signed at Paris in April 1814 Elba was conferred upon him and he resided there from May 1814 till Feb. 1815. Elba was taken by Tuscany in July 1815. The industries are mining and fishing. Most of the inhabitants are from Tuscany and are superstitious but industrious. Area 86 sq. m. pop. (1911) 9600.

Elbe, an important river flowing through Czechoslovakia and Germany. It rises in the N. of the former country among the S. slopes of the Riesengebirge Mountains and flows first S. and then W. to the border turning sharply N. to find a way through the

Mittelgebirge Mountains. During this part of its course the most notable tributaries are the Moldau and the Elger. It continues through Saxony first N.W. and then N. until it is joined by the Havel. Then it turns N.W. again and proceeds in a fairly straight line to its mouth in the North Sea. Important tributaries in its German course are the Mulde, Saale and Elde. Of the total length of 690 m. c. 500 m. are navigable. Important cities on its banks are Hamburg, Dresden, Magdeburg and Wittenberg. A canal connects the Elbe with the Oder and another canal is in course of construction to unite the Elbe with the Rhine. Though of less commercial importance than the Rhine the Elbe carries a great deal of traffic.

Since the World War the navigation and administration of the Elbe has been in the hands of an International Commission and the river is free to all traffic.

Elberfeld manufacturing town in the Rhine province Germany, the Manchester of Germany. Manufactures include textiles, cotton, wool, leather, paper, stained glass and chemicals. Pop. 165,000. See WUPPERTAL.

Elbeuf (ELBEUF) town and river port, department of Seine Inférieure, France, c. 15 m. from Rouen, an important centre of the textile and tannery industry. Pop. c. 18,000.

Elbing, Baltic port of E. Prussia on the Elbe near the Frische Haff. There are large ironworks in the town which manufacture locomotives and agricultural machinery, textiles are of some importance and there is a large shipbuilding yard. Elbing rose to importance as a Hanseatic town after the 13th cent. By the 18th cent. it had become decrepit but Prussia recovered the port from Poland in 1717 and the town advanced in importance. Pop. 71,000.

Elburz (or *Alburz*) the highest mountain in the Caucasus. It lies somewhat to the N. of the main chain near the border of the Kuban and Terek provinces. It is composed of

two extinct volcanic peaks with a maximum elevation of 18,526 ft. It was first ascended in 1829. Tradition alleges that it was the first resting-place of the Ark after the Flood.

Elchungen, village in Bavaria, 5 m. from Ulm, made famous during the Napoleonic Wars by Marshal Ney, who secured the bridge and defeated the Austrians in 1805. Thus won him the title of Duke of Elchungen.

Elder (bot.), a member of the Caprifoliaceæ, related to honeysuckle. The common elder is a small tree remarkable for the large quantity of pith contained in its young branches and for the elasticity of its wood. The leaves are pinnate, of a strong, unpleasant odour. The flowers are creamy white, and of a sweet though somewhat sickly smell; the fruit is globose, shining, dark purple, or rarely white. The tree was formerly held in high repute for its medicinal properties, and preparations are still used in rural districts. A pleasant wine is made from the fruit. It flowers in June. The dwarf elder, said to have been introduced by the Danes, has white, pink-tipped, sweet-scented flowers and black berries.

Eldon, John Scott, 1st Earl of (1751-1838), English lawyer and Lord Chancellor, became Attorney-General in 1793, conducting high treason prosecutions against Horne Tooke and other sympathisers with the French Revolutionaries. He was made a Baron (1799), and was Chief Justice of the Common Pleas in 1799 and 1801, from 1807-27 he was Lord Chancellor. He was a bitter opponent of Catholic Emancipation, and resigned when Canning, who advocated it, became Premier. Though an opponent of reform, Eldon greatly influenced the development of the Laws of Equity.

Eleanor of Aquitaine, (c. 1122-1204), wife of Henry II of England, whom she married in 1152 after a divorce from Louis VII of France. Henry incurred Louis's enmity by acquiring through her Aquitaine, which remained in England's possession for 300 years.

Henry later deserted her and she encouraged her sons, Richard and John, in their revolt against him in France in 1173. Eleanor exerted great influence during the reign of Richard I and the early years of John's.

Eleanor of Castile (d. 1290), married Edward I of England in 1254. By this marriage Edward secured control of Ponthieu, Montreuil, and Gascony.

Eleatic School, see PHILOSOPHY, ANCIENT.

Elecampane (*Inula Helenum*), a common perennial plant belonging to the Compositæ family, stout, 3-5 ft. high, with very large, oblong, or egg-shaped, toothed leaves, downy beneath, the upper ones embracing the stem, flowers—a few very large terminal heads, bright yellow. The roots contain a white starchy powder named inuline, a volatile oil, a soft acrid resin, and a bitter extract, it is used in diseases of the chest and lungs, and furnishes an ingredient in the manufacture of absinthe. It grows in moist pastures, and flowers in July and Aug.

Election (law), equitable principle whereby a person having two inconsistent rights is bound to choose between them, e.g. where, in a will, A gives B's property to C, and his own property to B, B must elect between rejecting A's gift and keeping his own property, or giving his property to C in accordance with A's wish and taking A's gift as compensation.

Election, public choice of governmental representatives under a democratic system. In most cases election applies only to a part of the legislative body, as for example, to the House of Commons in Great Britain, and this expression of the sovereignty of the people is usually modified by some non-elective body, such as the House of Lords, the Monarch, or other privileged person or persons.

The extension of the electoral system was coincident with the growth of the democratic idea of equality which followed on the French and American revolutions. Two factors entered in. Who should be eligible to

stand as candidate? and Who should be able to vote? The 19th cent witnessed an increasing freedom in both respects. At first heavy property qualifications were required for candidature. These were gradually dropped until to-day in Great Britain three qualifications only remain as explained below. In other countries the minimum age varies from 18 (Russia) to 30 (Czechoslovakia Austria Norway Japan Turkey) and the minimum number of supporters from 10 (Canada Portugal) to 100 (Czechoslovakia Belgium). In the post War period there has in certain countries been a reaction from freedom of candidature which is confined to supporters of the existing régime or ruling party (Germany Italy Russia Yugoslavia).

Similarly the franchise has been steadily widened and original property qualifications are now reduced in Great Britain and several other countries to 6 months residence all adult nationals of either sex above the age of 21 being entitled to vote. The minimum age varies else here from 18 to 25 and in most Latin countries as well as Holland Belgium & Africa and Japan women have not yet secured the franchise.

Conditions of polling have improved with a view to securing the voter from outside influence and obtaining absolute honesty in counting. Secret ballot (first introduced in S. Australia in 1856) is now almost universal an exception being the rural districts of Hungary. In Great Britain agents of the candidates co-operate in counting and supervising the poll. Candidates commonly address meetings and do everything possible to bring their views before the public thus enabling the latter to judge for themselves whom they will support. Candidates must not however exert undue influence by bribes of money food drink or other gifts by force or violence or by excessive expenditure i.e. above 5d per elector in boroughs and 2d per elector in counties. In the United States however huge sums are

expended amounting to some £5 millions on a presidential election alone and large numbers of official posts are in the gift of the successful party.

Various forms of representation are practised. In Great Britain any number of candidates may stand in each constituency the one who obtains the most votes being elected. Although this appears perfectly fair in the individual instance it often means that over the whole country a party with a large aggregate vote may through being almost everywhere slightly in the minority be almost unrepresented. For this several remedies are in use. In France when there is no absolute majority the lowest candidates with draw and a second ballot takes place between the leaders. Elsewhere candidates are elected in large constituencies in proportion to the total votes cast (see PROPORTIONAL REPRESENTATION).

Elections Parliamentary. Until the Ballot Act 1872 the nomination of candidates for election to the House of Commons took place at a hustings. The candidates were proposed and seconded in commendatory speeches addressed to a casual crowd composed mainly of persons not entitled to vote. The candidates explained their views and if the election was contested a show of hands was demanded by the *returning officer* i.e. the officer appointed to conduct the election in the constituency. Whatever the result of the show of hands a poll was demanded on behalf of the candidate for whom fewest hands were held up and at the place and time fixed for the poll the voters announced publicly their choice. Nominations were frequently accompanied by grave disorders and much intimidation took place.

Under the Ballot Act the returning officer upon receipt of his authorisation a writ issued by the Crown Office in Chancery must announce the day and place of election and of the poll if contested. The Representation of the People Act 1918 required all

elections to be held on the same day. Nomination day is the 8th day after the date of the Proclamation summoning a new Parliament. In the case of a by-election, the election takes place, in a county within 9 in a borough within 7 days after the receipt of the writ. On the date fixed for the election, the candidates must be nominated by 10 registered electors, and, to prevent frivolous candidatures, each candidate must deposit £150 to be forfeited to the Crown if he fails to secure one-eighth of the total votes cast. One hour is allowed for nomination, and if no more candidates are nominated than there are vacancies, the election is made and the names are returned to the Crown Office in Chancery. If the election is contested, it is adjourned to a polling day, which, in the case of a general election, is fixed as the 9th day after the day of nomination.

Convenient polling places are established by the authorities, and qualified electors (see *FRANCHISE*) may deliver their votes there between 8 a.m. and 8 p.m., or if the candidates so desire, 7 a.m.-9 p.m., on the day appointed. The elector must attend in person, a ballot paper is delivered to him containing the names of the candidates, against one of which he places a mark, which he is able to do in secret, the paper is placed in a box, and at the conclusion of the poll the polling boxes are sent to the returning officers at the place of election, where the votes are counted and the result declared. An elector whose name is on the absent voters list and who has an address in the United Kingdom recorded on the list, may send in his ballot paper by post. If his name is on the absent voters list and he has satisfied the registration officer that he will probably be at the time of a parliamentary election at sea or out of the United Kingdom, he may appoint a proxy to vote for him, only the spouse, parent, brother or sister of the elector, or another elector registered for the same constituency

may be appointed proxy, person can vote as proxy on behalf of more than 2 absent voters in constituency, unless he is voting of the relatives above mentioned. The Ballot Act does not apply to University elections, where the usual procedure is the usual procedure.

Election, a term used by Cæsar to denote the process of the choice of those predestined to succeed. They are the "elect" *S. CAESAR*.

Electors, German prince elected the Holy Roman Emperor. By the Golden Bull (1356), the number was limited to seven. document governed elections to extinction of the Imperial title.

Electra, in Greek mythology, daughter of Agamemnon and Clytemnestra, whom she helped to murder. She is the heroine of tragedy by Sophocles, Æschylus, and Euripides.

Electrical Condenser, see *CONDENSER*.

Electrical Measuring Instruments, nearly all depend upon the action of electrostatic or electromagnetic forces.

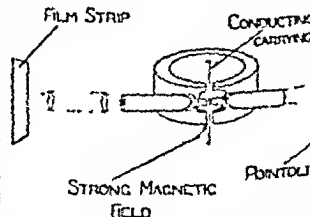


FIG. 1.—String Galvanometer.

upon some part capable of being deflected. The motion of this part is resisted by a force which increases as the velocity of the motion increases, and the deflection is given by the extent of the motion when the part becomes stationary, owing to the acting force being balanced by a "restoring" force being in equilibrium. Since the indication of the instrument cannot be read until the motion has ceased, the deflection is the

cases to be damped for otherwise it will swing to and fro for some time before coming to rest.

The simplest of all electrical instruments is the string galvanometer which consists of a single thread of metal or silvered quartz lightly stretched between two terminals and exposed to a strong magnetic field. When a current is passed the thread experiences a deflecting force which is resisted by its own elasticity. It thus moves to a position in which the two forces balance. The motion is observed by a microscope. This apparatus was invented by the physiologist Einthoven in 1911 for the pur-

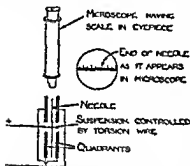


FIG. 2.—String or Needle Electrometer

pose of observing nerve currents. As a closely analogous instrument we may take the string or needle electrometer in which the metal wire or quartz fibre is situated in a strong electrostatic field. This has also been of the greatest use in radioactive photo-electric spectrograph and meteorological work and in the form given to it by Prof. Lindemann of Oxford is so small as to be housed in a little cell on an ordinary microscope slide. The principle first employed in 1836 by Sturgeon in England and revived and improved by Lord Kelvin in 1867 of employing a powerful permanent or electro-magnet to produce a field in which turns a suspended coil carrying the current to be

measured was applied by Weston in 1888 to the production of a moving coil pointer instrument a type now universally known and manufactured

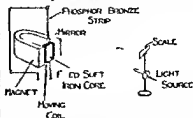


FIG. 3.—Moving-coil Instrument.

in millions annually. In the form of a mirror galvanometer it consists of a coil of fine wire wound on an aluminium frame and carrying a small mirror the whole being suspended between the poles of a permanent magnet by means of a phosphor bronze strip which leads the current to one end of the coil a slack fine strip or wire leading it from below to the other end of the coil. In the pointer instrument the coil is pivoted between jewels and carries a pointer travelling over a scale. The instrument is now used almost universally for everyday indication of direct current and

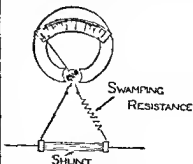


FIG. 4.—Shunt Instrument.

voltage and has been developed to a point at which manufacture in large quantities can be conducted very cheaply. Also the quality of the steel

used for magnets, and particularly the permanence of its strength, have improved steadily, until to-day a moving-coil instrument will keep its calibration constant for many years. It is usually described as a milli-ammeter or milli-voltmeter, it is easy to make these instruments sensitive to one-millionth of an ampere per scale division. For the measurement of higher currents they are used with a shunt which has a low resistance, through which the main current is passed, the milli-voltmeter being connected in parallel with it. The current then divides itself between the low-resistance shunt and the instrument circuit, inversely in proportion to their resistance, and the scale is calibrated

of the first wire due to the current passing being transmitted to the second wire, where it is greatly magnified. In a modification the heat, generated by the current to be measured in the resistance wire, excites a thermojunction (see ELECTRICITY) connected to a moving-coil milli-voltmeter. The heating may be either by direct contact or by radiation and convection over an air-gap.

The measurement of electric power is best effected by instruments which are actuated by the magnetic force exerted upon one another by two coils, one carrying the main current, and the other a fine wire high-resistance coil, carrying a current proportional to the voltage of the circuit. The force between the coils in any given position is then proportional to the product of the ampere turns of the two coils, and these ampere turns in each case are a measure of the current and voltage of the circuit, the force between the coils is then a measure of the product of current and voltage, i.e. power.

Electrostatic instruments are all based fundamentally upon the attraction or repulsion exerted between charged conductors. The gold-leaf electrostatic voltmeter was the first of this type, and the discovery of radioactivity led to the widest possible use of it in scientific investigation. A description will be found in the article ELECTRICITY.

The measurement of alternating current involves principles too difficult to be explained in this article. It may be measured by moving-iron and hot-wire instruments, but much more important are methods depending upon effects peculiar to alternating current. One of these depends upon the production of a moving magnetic field by means of two adjacent magnetic poles of different phase. In the article ELECTRIC DYNAMOS AND MOTORS the mode of action of the polyphase motor is explained. This, however, depends upon the use of a supply of current at two or more phases. It is, however, possible to obtain the same effect by means of

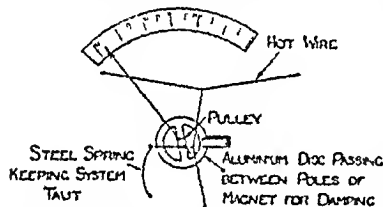


FIG 5—Hot wire Instrument

so as to indicate directly the current in the main circuit.

In hot-wire instruments, the heating effect of the current is used. These instruments were much used in the early days of electrical power supply, on account of their simplicity, but they have very serious disadvantages. The current is passed through a wire of some suitable material usually stretched between two terminals, and having attached to its centre a second wire put under tension by a spring. When a current is passed through the first wire, a very slight expansion due to the heat generated causes the sag in the middle to increase considerably, and this motion is transmitted to a pointer by the second wire. More commonly, the second wire is led to a fixed terminal, and a third wire led from its middle to a spring. This is called the double sag number, the sag

current of a single phase. The simplest case of this kind is that of the so-called shielded pole—a device to be found on all alternating electricity supply meters. An alternating magnet has its pole divided as shown in Fig. 6, one half of it being surrounded by a copper ring, the other half being left bare. The whole pole is wound with a magnetising coil supplied with alternating current. The effect of the copper ring, a short-circuited secondary, is to retard the magnetisation of that part of the iron around which it is placed. The result is to introduce a difference of phase between the magnetism from the unshielded pole and the shielded pole, the effect of which is as if the magnetic pole were moved in the direction of the arrow each time it is energised. Everyone knows of the famous experiment of Arago, which was the very first observation of electro-magnetic effect. A magnetic needle is hung over a copper disc which can be rotated. It is found that the copper disc drags the magnet around with it by the eddy currents induced in the disc as it is moved through the field of the magnet. Conversely, if the disc is hung up or pivoted so that it is free to rotate and the magnet is whirled round the disc will follow the magnet. In the

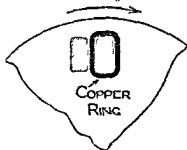


FIG. 6.—Shielded pole instrument.

diagram, Fig. 6 the effect of the alternating shielded pole is exactly equivalent to an arrangement such as that shown in Fig. 7 where a magnetic

needle instead of being whirled round concentrically with the disc is turned so that N. and S. poles alternately move across it. This is the principle

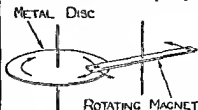


FIG. 7.—Rotating disc.

of the ordinary supply meter and of many other alternating-current instruments which are far too numerous and various to be described in this article. Such instruments may be described as induction wattmeters while the supply meters are watt-hour meters.

The electrical energy delivered to a consumer is measured by the product of the voltage, the current and the time; the voltage and current multiplied together giving the watts, and this multiplied by the time gives the watt hours or seconds. The legal unit for electricity supply is the Board of Trade unit, which is defined as 1 kilowatt hour, this being the energy delivered to a consumer who takes say 6 amperes of current at 200 volts for 1 hour, that is to say 1000 watts for an hour. The instrument for recording the consumption of energy must however perform this multiplication sum at every instant for the consumer may switch lamps and motors on and off; the instrument must thus integrate the power with respect to time that is give us the sum obtained by dividing the time up into very small intervals, multiplying each of these by the power consumption during that interval and adding up the result.

Every supply station is compelled by law to maintain the voltage for the consumer as constant as possible. Hence it is also legal to assume the

voltage to be constant in measuring the power, and the simplest type of electricity-supply meter depends for its action upon a measurement of the

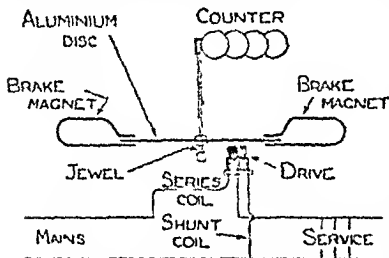


FIG. 8—Alternating Meter

ampere-hours, in other words, of the quantity of electricity which has flowed through the premises

One form of ampere-hour meter depends upon the passage of the current to be measured through a little circular pool of mercury from the centre of the same to the circumference. The pool is situated in a magnetic field with the lines vertical, produced by a powerful permanent magnet, the effect is to produce a driving force in the mercury in the pool, tending to make it turn round. More commonly, a disc of copper floats in the mercury, its edge and centre being amalgamated or wetted with mercury, the current flows through this also, and it is likewise acted upon by a force tending to turn it round. The disc is geared to a counter showing the number of revolutions which it has made, and this is proportional to the current multiplied by the time during which it has acted, provided, of course, that the disc spins at a speed proportional to the current flowing through it.

Alternating meters are, however, nearly all constructed on the principle of driving a spindle by means of a force produced by the product of the instantaneous value of the voltage and the current, and opposing the rotation of the spindle by means of a magnetic brake which retards it by a force which

increases in proportion to its speed. The magnetic brake consists of an aluminium disc rotating between the poles of a permanent steel magnet or magnets. The number of revolutions made by the disc is a measure of the total consumption of energy.

An important class of electrical instruments are those which record by means of pen and ink upon a paper chart, or by means of light upon a photographic film. The simplest type of such an instrument, and one very often used, consists of a moving coil or other type of instrument movement, according to the electrical quantity to be measured, having a pen attached to its pointer and travelling over a paper disc turned by a clock. A development is to employ a strip of paper wound round a drum turned by a clock, or better still, a long roll of paper, sufficient for a considerable period, pulled past the pen by means of a clock. In the case of the disc, the line traversed by the pen is curved, and the distance in the other direction, representing a certain length of time, varies from the centre to the circumference of the disc. With the drum recorder, the time scale is even all over the drum. A further development consists in replacing the pen by a "dotting device". The pointer of the instrument is provided with a knife

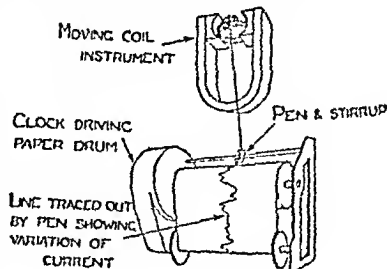


FIG. 9—Chart Instrument

edge, and between it and the paper is a thread coated with ink. As a rule most of the time the pointer with its knife edge is swinging freely, but at

frequent intervals it is pressed against the thread and the paper on the drum whereby a mark is made on the paper. The resulting record curve is made up of a series of dots which is no disadvantage while the effect of the pen friction on the accuracy of the instrument is eliminated. In this way any pointer instrument can be made to record without loss of sensitiveness and accuracy. These instruments are continually enlarging their field of application which began with their use for recording temperature by means of thermo-electric couples. They have proved so reliable that the natural first thought of the instrument designer called upon to record anything is to find means by which a small electric current can be obtained proportional to the quantity to be measured; this current is then recorded on a standard recording milliammeter.

The drawback to all pointer instruments is the fact that the pointer necessarily possesses considerable inertia as compared with the forces available to move it, and hence moves

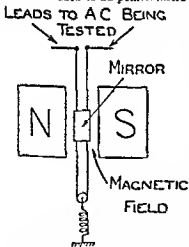


FIG. 10.—Oscillograph.

comparatively slowly so that pointer instruments cannot be used for recording rapidly fluctuating quantities.

We have spoken of the string galvanometer and electrometer the motions of which can be recorded by projecting an image of it through a microscope on to a moving photographic film. It is however often more convenient to employ a tiny mirror upon the moving part and cause this to throw a spot of light upon the moving photographic film. In this case the moving part must rotate. The best known instrument of this kind is the *oscillograph* which takes a great many forms but consists essentially of a loop of fine wire carrying the current to be measured and situated in a powerful magnetic field. Between the two trips forming the loop is a tiny mirror the loop being kept under tension by means of a fine spring. This arrangement can be made so rapid in its action as to require less than $\frac{1}{100}$ of a second to take up its reading. The oscillograph was originally invented to enable the exact form of the curve of an alternating current to be studied but it has proved of the greatest importance in recording sound photographically in the talking picture (see also CATHODE RAY OSCILLOGRAPH).

A word should be said concerning the Ohmmeter an instrument employed for measuring resistance directly. This consists of a pair of coils fixed together on the same axis and able to turn in a magnetic field.

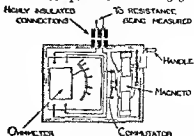


FIG. 11.—Ohmmeter.

A word should be said concerning the Ohmmeter an instrument employed for measuring resistance directly. This consists of a pair of coils fixed together on the same axis and able to turn in a magnetic field.

A pointer is provided travelling over a scale graduated in ohms. A voltage is applied to the resistance to be measured, and to one of the coils (generally through a constant resistance). The current produced in the unknown resistance is sent through the other coil. Several arrangements of the coils are used but all of them are such that the deflection of the pointer indicates the ratio between the currents and the two coils. The great advantage of this instrument is, that the measurement of the resistance is independent of the applied voltage. The commonest application of this instrument is for the measurement of insulation resistance. The voltage employed is generated by a dynamo turned by hand, giving c. 500 volts direct current. This is sufficient to send a small current through a resistance of the magnitude presented by insulation of a house service, a machine, or a motor, that is to say, a million ohms or more. See also ELECTRICAL MEASUREMENTS

Electrical Transmission of Power.

The initial practical applications of electricity utilised its continuous passage through a conductor, or more simply expressed, direct current. The first form of transmission consisted of two cables, one carrying direct current from the positive terminal of the generator to the load, the other completing the circuit back to the negative terminal of the generator.

The energy which is lost in the cable is given by the product of the voltage drop along it and the current in it. It is also directly proportional to the length of the cable and inversely proportional to its sectional area. To decrease the loss when a given current is passing, it is necessary either to decrease the length of the cable or to increase its cross sectional area. But in practice both these alternatives are impracticable.

Since the power is given by the product of voltage and current, an increase of voltage would result in a reduction of current if the power

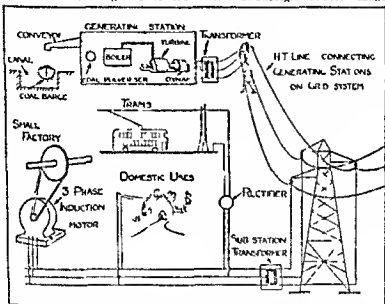
transmitted remained unaltered, and consequently a reduction of the size of cable necessary for the transmission. The logical development was, therefore, an attempt to increase the voltage of supply, but many serious disadvantages were encountered. The most important of these is probably the fact that the voltage at which the ordinary consumer may be supplied with safety is limited. Most of the present regulations for the supply of electric power to the ordinary consumer limit the voltage which may be used to a low pressure supply of 250 volts. For special purposes a "medium-pressure supply," up to 650 volts, is allowed, but only when special precautions are observed. By English Board of Trade regulations, voltages above 650 volts, "high-pressure supply," may not be delivered to any consumer.

Attention had been turned to the problems of alternating currents whilst experience was being gained with direct current, and it soon became evident that electrical power could be more readily transmitted in the alternating than in the direct current form. In an alternating-current circuit, both the direction of current and the voltage between the ends of the circuit reverse periodically and uniformly. A complete change of current from positive to negative and back to positive is called a cycle, and alternating-current power is generated usually at 25, 50, or 60 cycles per second. Interest in alternating currents brought about the development of the transformer (*q.v.*). By its means it is possible to generate at a low voltage, "step-up" the voltage by the transformer to a high value, transmit the electrical power along cables at a high voltage, "step-down" to the normal voltage of supply by another transformer, and distribute the electrical energy to the consumers at this normal voltage.

As with direct current, the initial system of alternating-current transmission was along two cables. This is known as single-phase transmission.

In 1889 a double cable was laid in London from Deptford to Bond Street and back a distance of c. 12 m. A step-up transformer connected to one pair of ends supplied a voltage of 240 volts to the line whilst a step-down transformer connected to the other pair supplied loads at normal voltage. Generator and load were situated together and investigation of the

Electricity) and its effects are very noticeable on long transmission lines. The no-load delivery voltage of a transmission line in California 240 m long and with a generated voltage of 140 000 volt is 10 per cent or 15 000 volts higher than the generated voltage. The effect is more pronounced with underground than overhead cables but underground cables cannot



Power House 1 an mission Line and Consumer Installation.

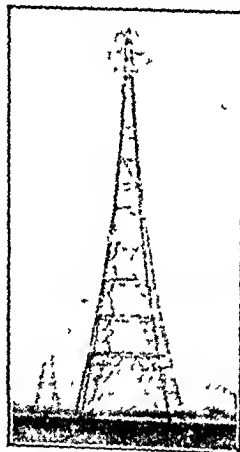
properties of the line could be carried out conveniently. Ferranti to whom we are indebted for the work carried out on this experimental cable obtained many interesting results. He discovered that an increase of current or load transmitted by the line resulted in a decrease of the voltage at the load end but that when no power was transmitted the voltage at the load end was greater than that at the generator end. This latter effect is due to the capacity of the line (see

be employed economically for long distance transmission.

In 1890 the 3 phase system was introduced (see DYNAMOS AND MOTORS) by Tesla and has proved a considerable improvement on the single phase system. Mathematical analysis shows that with the 3 phase system almost twice the power can be transmitted over 1.5 times the amount of conductor as compared with the single-phase system.

In distribution systems the cable

pass from the generating station to substations which distribute to the consumer. These cables may radiate as separate lines to each substation or one line may pass from the generating station through all substations, and back again. In the former case auxiliary cables are laid to insure continuity of service in the event of a breakdown, in the latter auxiliary cables are unnecessary, as there are always two alternative routes around the cable. These systems are known as the radial and the ring main



Suspension Tower (Grid System)

systems, and in modern transmission they are combined to form the network system, by which it is possible to supply any one consumer along two or more alternative routes, thus ensuring reliability of service.

The conditions for efficient, practicable, and economical trans-

mission are that it shall be (a) produced on a large scale, (b) produced continuously, (c) transmitted at a high voltage, (d) distributed at a low voltage, and the manner in which they are met may be illustrated by reference to the Grid System, which has been developed in Great Britain under the guidance of the Central Electricity Board inaugurated in 1926.

A large central generating station is situated at some convenient point. The choice of site is determined by consideration of the situation of the consumers, the cost of the transmission and distribution lines to the consumers,

the cost of transport of fuel (coal) from mine to station, and the convenience of water supply. The capacity is determined from the nature of the anticipated load factor in the district and the proximity to other stations. At the generating station alternating current power is produced. By means of transformers the voltage is stepped up to 132 000 volts (132 kido-volts (kV), and passes to the overhead, "high-tension" lines. These lines carry the power direct to substations. The primary purpose of the substations is to transform the power from the high voltage supply to an intermediate voltage for local distribution. The final transformation to the low voltage supply (200-250 volts) is effected by transformers which are situated around each substation in positions convenient for direct supply to the consumers. By the network system arrangements are made so that in the event of breakdown of one line of supply power may be sent along other lines, and to permit the even distribution of load on all generating stations they are also interconnected by direct and ring mains. The result is a network of lines interconnecting all stations, substations, and consumers' transformers. By this means generating stations may be made of large capacity, and the load on each station may be kept fairly uniform, which are the two requisite conditions for economical production of power.

The grid system contains 2600 m of 132 kV overhead lines. The cable consists of a central core of 7 strands of galvanised steel wire of 0.11 in diameter, surrounded by 30 strands of aluminium wire of the same size. The steel core gives strength for the cable to support the enormous stress to which it is subjected when spanning between towers. The aluminium improves the electrical property of the cable, besides acting as a protection for the steel against atmospheric conditions. Illustrations of a typical tower are given. The towers are spaced 900 ft apart normally, and are of such a height that

the cables pass 2^o ft above the ground or 8 ft above buildings at their lowest point. A cable containing 19 strands of steel and 18 of aluminium was designed to span the Forth. This cable spans a distance of 3050 ft between towers 339 ft high whilst its lowest point is held 18 ft above high water level.

Overhead cables can only be used in thinly populated areas underground cables being used where population is dense.

The insulators supporting the cables are of porcelain and are strung in series between the line cable and the support.

They are designed to stand 340 kV without breakdown when wet corresponding to the condition of rain. All transformers operating at 132 kV are designed to work in the open their load capacities being determined from a consideration of the interchange of loads between power stations and of the requirements at substations.

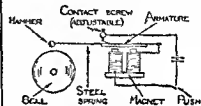
Electric Bells. The electric bell is operated by an electro magnet which attracts



Insulators.

a piece of iron called the armature bell at one end by a flat spring and carrying at the other a wire to which a knob of metal is attached which when the armature is attracted strikes the bell. The current is made through the magnet through the point of a screw which presses on a contact on the armature hence when the latter moves towards

the magnet it breaks the circuit thus reducing the attractive force of the magnet the armature then swings back and makes contact again the whole process repeating rapidly. Bells are operated with low tension current usually from dry batteries but also from bell transformer if alternating-current supply is available. The contact screw may in time fail to make contact with the armature since here



Electric Bell

a spark is formed which gradually burns the metal. This should be cleaned with fine emery paper.

Electric Cables, see ELECTRICAL TRANSMISSION OF POWER.

Electric Eel, an eel like fish not related to the common eel and conger (q.v.) but more akin to the catfish. It is found in the rivers and marshes of the N parts of S America and may be 8 ft long and nearly as thick as a man's thigh. The electric organ consisting of a gelatinous substance derived from muscular tissue is situated along the tail which forms four fifths of the length of the fish. The shock is powerful enough to knock down a mule stepping into the water. The organ however is mostly used for killing smaller fishes on which the eel feeds.

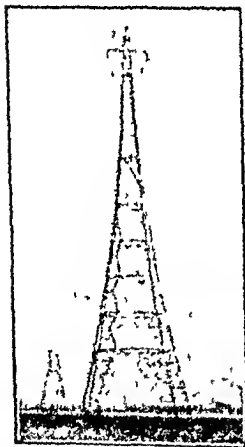
Electric Furnace, see ELECTRO-CHEMISTRY TECHNICAL.

Electric Generator see DYNAMO AND ELECTRIC MOTORS.

Electric Heating see HEATING ELECTRIC.

Electricity. It had long been known that two pieces of amber repelled one another after being rubbed with silk and that glass similarly treated attracted electrified amber. This was

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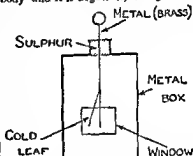
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there are no free electrons but in liquids which conduct electricity the current is conveyed by a flow of charged chemical atoms or complexes of atoms in opposite directions the e charged atoms or complexes being termed ions. They are of two kinds, one having an excess of electrons and the other a deficiency the current is the sum of the electricity carried by these two streams.

Electrostatics deals with the properties of stationary electricity it is convenient to speak of positive and negative electrification and generally to treat the subject as if there were two electric fluids of opposite sign which in equal quantities neutralise one another. The simplest instrument for exhibiting the properties of electrical charges is the gold leaf electroscope (Fig 1). It consists of a metal plate suspended in a metal box provided with a transparent window the metal being insulated from the box by a piece of amber or sulphur a strip of gold leaf is attached at its upper end to the metal. Where the metal passes through the sulphur it is reduced to a wire and may terminate in a knob or plate outside the box. When the metal plate and leaf are electrified they repel one another since they both are charged with electricity of the same sign. The leaf then takes up a position as shown in the Figure in which its weight balances the electric repulsion and if it is observed by means of a low power microscope provided with a divided scale in the eye piece this very simple apparatus can be used for the measurement of electricity and has in fact served excellently to develop the investigation of radioactivity ($q v$). It can be charged by touching it with a piece of ebonite or amber which has been rubbed with cloth or silk but it is generally electrified by induction. We find that if an electrified body is brought near to it the leaves diverge if the body is removed they collapse again. But if we touch the metal knob while the leaves are diverged they collapse. If we then remove the

electrified body and also our finger the leaves diverge again to exactly the same extent as before. This effect is easily explained. If the body that we brought near is positively charged it attracts some of the free electrons in the metal to the knob thus leaving the leaves positively charged that is to say deficient in electrons. If the knob is negatively charged. If we touch the knob that is to say put it in contact with the earth which is a limitless reservoir of electrons we supply the deficiency in the leaves without of course affecting those piled up in the knob. When the finger and the body are removed the latter electrons spread over the whole insulated body and it is negatively charged.



The electric charge resides on the surface of a conductor. The most striking demonstration of this is Faraday's Cage Experiment. He constructed a cage large enough to enclose himself and his instruments which could be electrified even to the point of emitting a blaze of sparks inside the cage the most delicate instrument even when connected to the cage exhibited not the slightest disturbance.

These experiments led Faraday to the most fundamental and fruitful of all physical conceptions that of lines of force. As in the case of gravitation we can go very far by simply assuming action at a distance. If we know the law of force we can calculate

held to indicate that there were two kinds of electricity—positive and negative. The first quantitative experiments, however, were not performed until the time of Coulomb, who proved that two electrified bodies attract or repel one another, as the case may be, according to a law of force similar to that discovered by Newton for gravitation, namely, in inverse proportion to the square of the distance between them, and directly as the product of the quantities of electricity with which they are charged.

Bodies can be classified roughly as conductors or insulators of electricity. An electric charge communicated to any part of a body of the first kind immediately flows all over the body, whereas with bodies of the second class no such flow takes place. There is no perfect insulator of electricity in the absolute sense, but quartz and amber are perfect for most practical purposes. No perfect conductors of electricity are known to exist at ordinary temperatures, but many metals, when cooled to within a few degrees of the absolute zero, oppose no resistance to the flow of electricity (*see* SUPERCONDUCTIVITY).

Until quite recently attempts to explain electricity as a property of matter never ceased, just as heat and sound are properties of matter, being manifestations of its motion and inertia. We now explain matter as a property of electricity. As stated in the article ATOM, we know that matter consists of atoms which are built up of electric charges of two kinds, positive and negative. The negative elementary charges, or electrons, can be obtained in the free state, and an examination of their properties shows that they behave like weightless particles negatively charged. An electrified body possesses an extra mass or inertia, and also an extra weight, due to its charge.

The reason why there is such a thing as a science of electricity is that electric conductors are so constituted that a small proportion of the negative electrons within them are freely mov-

able, they behave for most practical purposes as if they are filled like a gas into the spaces between the atoms of the metal. If we imagine a tube filled with shot, representing the atoms, we can produce a current of air through it, the air molecules representing the electrons. This current will experience resistance, but the air pressure throughout the tube will always equalise itself almost instantaneously, unless there is a constant flow of gas when the pressure will, of course, fall continuously in the direction of the flow.

In the case of a gas, it is necessary to provide a tube to confine it. When we remember that the electrons in a metal have become detached (more or less) from the atoms, we see that they cannot easily escape, because, the atom as a whole being made up of equal quantities of positive and negative charges, the atom which an electron has left acquires a surplus positive charge. When the metal is strongly heated, the electrons actually escape, this is the principle upon which the filament of a wireless valve works (*see* WIRELESS).

A body is electrified positively by removing electrons from it, and negatively by giving it a surplus of electrons. Generally speaking, close contact between two solid bodies will result in their being found to be electrified on separation. In the case of insulating bodies, friction is necessary and results in an uneven distribution of electrons, which, however, does not equalise itself when the bodies are separated, as in the case of metals, for in insulators the electrons are bound to the atoms.

For practical purposes the old names of positive and negative electricity are most convenient, though it is unfortunate that the wrong convention was adopted to describe the flow of electricity, we speak of the current flowing in a metal as if positive and not negative electricity were flowing. In a liquid, as explained in the article ELECTRO-CHEMISTRY,

We must now consider electricity from the point of view of quantity. We find that to bring a given insulated conductor to a certain difference of potential as against the earth or another conductor surrounding it we require to give it a certain definite quantity of electricity.

In the electrostatic system of

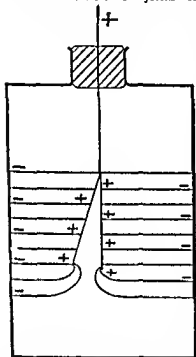


FIG. 4.

measurement we define unit quantity of electricity as that which situated on a small sphere distant 1 centimetre from another similar and similarly charged sphere, attracts it with a force of 1 dyne (see MECHANICS).

We define the capacity of a conductor by the quantity of electricity necessary to raise its potential by unit amount. If we have a small sphere

contained in a spherical metal box we require to transfer this amount of electricity from the box to the sphere to raise its potential above that of the box by unit amount. The sphere and the box together form what is called a condenser. A condenser thus consists of a pair of conductors not connected electrically.

It is found that the capacity of a condenser depends not only upon its geometrical form but also upon the nature of the material through which the lines of force pass from one pole or plate to the other. This material must be an insulator for we have seen that no electric force can exist inside a conductor. It is found that a condenser in which the plates are separated by an insulator has a higher capacity than the same condenser when the plates have no matter whatever between them that is are in a perfect vacuum. The figure by which the capacity of a vacuum condenser must be multiplied when the vacuum is replaced by an insulator is called the specific inductive capacity or more commonly the dielectric constant of the insulator and is a characteristic number for the substance. The dielectric constant of gases is slightly greater than 1 in hydrocarbons rubber and sulphur it ranges from 2 to 4 in minerals such as quartz and mica from 4 to 8 in glass from 6 to 10 while some organic liquids have much higher values such as alcohol 25 nitrobenzene 36. Pure water has the highest known constant, namely 81 but is far from being a good insulator.

Condensers are now very well known to most people owing to their application in wireless. Both air condensers usually variable and condensers having a solid dielectric (generally paraffined paper or mica) are used. A further account of these will be found in the article WIRELESS.

Until quite recently experimenting with static electricity was by means of electrical machines such as the Wimshurst. These depend for their

approximately how the planets will move round the sun, or, in the case of electricity, how the electrons will act upon one another. But if we direct our attention to the empty space around an electrified body, we feel

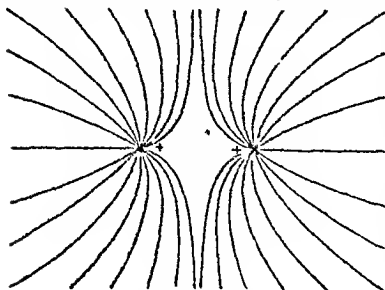


FIG 2

instinctively that it must somehow be modified by the presence of the body. We know that if we bring into it a charged body, it will be acted upon by a force, and Faraday conceived the idea of regarding this space as in a state of strain, a "field of force," mapped out, as it were, by "lines of force," the direction of which at any point is that of the force on a small charged body placed at that point. If such a charged body were free to move, it would travel along the line of force passing through it. Let us now suppose that we have two equal and opposite charged bodies far away from any other bodies. These will produce around themselves a field of force which can be represented, as in Fig 2, by curved lines. A small negatively charged body brought anywhere into this field will travel along the line on which it finds itself, towards the positively charged body.

The two charged bodies attract one another. Faraday imagined a line of force as a line of tension in the space between the bodies, almost like a piece of stretched rubber. Such a line always starts from a positive charge and ends on a negative charge (this statement being, as regards direction, a mere convention). In

order to make our picture correct, we must also assume that lines of force repel one another, causing them to assume the curves shown in the diagram. If we draw our picture on some plan such as to allow one line for one unit of charge on the body, the "flux density," that is to say, the number of lines passing through unit area at any point, will tell us the strength of the electric force at that point.

We speak of the difference of electric force between the two bodies as a difference of potential, again, conventionally, we talk of the positive end of a line of force as being at a higher potential than the negative end. The potential falls continuously along the line of force, and we can draw the dotted lines of Fig 3 through points of equal potential on the lines of force. These are called "equipotential lines."

Electric repulsion is now seen to be due to the repulsion of the lines of force, and the tension between their ends. In Fig 3 we have two bodies with equal charges of the same sign, with their lines of force, which end, say, on the walls of the room. We see that the lines of the two bodies are repelling one another, and also that their tension is, on the whole, directed so as to separate the bodies. In Fig. 4 we have a diagram of the gold-leaf

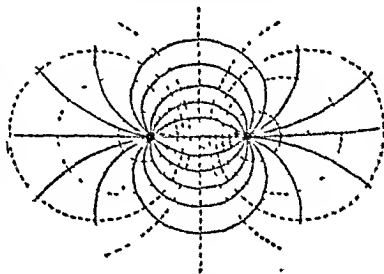
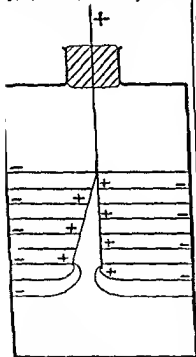


FIG 3

electroscope in which it is seen that the lines of force, starting from the leaf, end on the case, and pull the leaf away from the metal plate.

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F 4

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Until quite with static electrical

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action upon a mechanical arrangement for charging by induction, as already described, the charges being multiplied until a very high potential is obtained. The working of the machine requires that it should be given a small initial charge, effected usually by bringing near it an ebonite rod electrified by friction, and also that its insulation should be very good. Many solids, such as glass, which are excellent insulators, are liable to attract moisture to their surface, and so largely lose their good qualities, hence an electrical machine operates best in dry air.

The voltages concerned are very high indeed, that required to produce in air a spark only $\frac{1}{4}$ in long is nearly 20,000 volts. The reason why such experiments are harmless is that the sources of electric potential employed can deliver only a very small quantity. If we charge up a small condenser to 20,000 volts, we can discharge it through our bodies with a visible spark without more than a slight shock. A large condenser at the same potential but delivering much more electricity will produce a very severe and unpleasant shock; while if contact be made through the body with electricity supply mains at this voltage, or even one twenty times less, the result will almost certainly be fatal.

After "static" or stationary electricity had been studied for a century or so, an entirely new direction was given to the matter by Volta's discovery, in 1799, that a steady current of electricity can be produced. He found that when a plate of copper and a plate of zinc are dipped into a vessel containing sulphuric acid, and connected by a wire outside the cell, a steady flow of electricity takes place through the wire from the copper to the zinc. The copper plate remains positively charged as compared with the zinc plate, even though they are connected by the metal wire, and this wire becomes the seat of new phenomena. Heat is generated in it, if it is thin enough, the heat may cause it

to glow and even to melt. The heat observed is generated by the friction between this stream of electrons and the metallic atoms, exactly as heat may be generated by forcing water under high pressure through a number of fine orifices. This discovery forms the basis of the electric battery concerning which further information will be found in the article of that name, and under ELECTRO-CHEMISTRY.

We have spoken of the heating effect of the current. Another remarkable property is that it sets up a magnetic field around itself. We shall have to deal with this in much greater detail, but we may say that an ordinary compass needle set pointing N. and S. is deflected from this position when a wire carrying a current in a N and S direction is brought near to it. This early enabled electric currents to be measured.

A further effect of the current is its power of producing chemical decomposition. Thus, if the current is passed between two platinum wires dipping into water, the water is decomposed into its elements, hydrogen and oxygen.

By utilising these effects we are able to prove the following fundamental law, known by the name of Ohm, who discovered it in the year 1827. Ohm's Law states that the current produced in a conductor by a difference of electrical potential between its ends is proportional to this potential divided by a constant peculiar to the conductor and called its resistance. Thus, if we double the voltage, we double the current. Furthermore, any given conducting material possesses what is known as "specific resistance," defined as the resistance between opposite sides of a 1-centimetre cube of the material. Other things being equal, halving the cross-sectional area of a conductor and doubling its length both lead to doubling the resistance.

An analogy with water power will enable us to understand a slightly more difficult matter. Suppose we fill a tank at the top of a house with water,

and this water flows back to the ground through a pipe. The work done in filling the tank with water is proportional to the quantity of water carried upstairs and to the height of the tank. When the water is allowed to flow through a turbine at the bottom it can be made to give back nearly all the mechanical work expended in carrying it up, and this work is represented by the height that is to say the pressure of the water multiplied by its weight. A particular current of water at a given pressure will produce a certain output by the turbine usually measured in horse power. If we double the pressure we shall double the current and double the horse-power. If we have a larger turbine or open the tap wider we may get double the horse power by doubling the current of water. Thus the horse power or rate of doing work is proportional to the pressure multiplied by the current. The same is true in the case of electricity. Now when an electric current generates heat in a wire we know from the law of conservation of energy that this heat represents some other kind of energy which is being transformed. In this case it is electrical energy or power of doing work. The rate at which a current generates heat in a wire is therefore proportional not to the current but to the product of the voltage between the ends of the wire and the current. And since by Ohm's Law the current is again proportional to the voltage divided by the resistance the rate at which heat is generated is proportional to the square of the current multiplied by the resistance. This accounts for the fact that an ordinary electric lamp will not stand much excess of voltage over that for which it is rated.

Another method of producing a continuous current is by utilising the phenomenon of *thermo-electricity* (q. 2) but the generation of electricity on an industrial scale is now effected almost exclusively by electro-magnetic induction (q. 2).

Something must be said concerning the manner in which electrical quantities are measured a matter somewhat confusing even to experts. All physical units are based upon what is known as the C.G.S. system involving the three fundamental but arbitrary units the centimetre gramme and second as defined by international agreement upon standards kept in Paris. Whenever it is necessary to measure anything the physicist proceeds to define a unit involving these fundamental units using some property of the thing to be measured; thus electricity might be measured in many ways but it has been agreed to use two separate systems one the electrostatic system the other the electro-magnetic. The first starts by defining unit quantity of electricity as we have defined it above. The electro-magnetic system starts by defining unit magnetic poles. In this way two sets of units are obtained which have different dimensions that is to say each of them contains three fundamental units length mass and time in a different way. The ratio of the electrostatic to the electro-magnetic unit is as regards dimensions a velocity that is to say length divided by time and when these units are determined according to definition and actually compared it is found that this ratio is about 300 million metres per second in other words the velocity of light. It was this fact that first corroborated Maxwell's electro-magnetic theory of light which will be found discussed in the article **ELECTRO-MAGNETIC RADIATION**.

For practical purposes in technical work, the electro-magnetic system is used in the form settled by international agreement, the unit chosen being of a more practical size in multiples of 10 of the absolute units. They have been named after eminent scientists. The ampere unit of current is $\frac{1}{10}$ th of the absolute or C.G.S. unit the coulomb is the same the volt is 100 million times the C.G.S. unit the farad the unit of capacity is

1000th of the CGS unit; and is the henry, the unit of inductance, 1000 million times CGS. The prefixes milli- and micro- are used to indicate $\frac{1}{1000}$ and $\frac{1}{1000000}$ of the above units (e.g. microvolt, milli-ampere), and the prefix kilo is used to indicate 1,000 times, e.g. kilovolt.

The further properties of electricity and electric currents are dealt with in the article ELECTRO-MAGNETISM.

Bibliography J. H. Poynting and J. J. Thomson, *Electricity and Magnetism* (1924), H. A. Lorentz, *The Electron Theory*.

Electric Lighting, see LIGHTING, ARTIFICIAL.

Electric Motor, see DYNAMOS AND ELECTRIC MOTORS.

Electric Railways, see ELECTRIC TRACTION.

Electric Traction dates from the year 1879, when Messrs Siemens & Halske exhibited a small electric railway at the Berlin Exhibition. This was constructed on the *third-rail system*, such as is used to-day on some suburban electrified railways and on the London tubes. In this system the current is conveyed to the motors by means of a "live" rail, supported on insulators between the running rails, which latter serve as return conductors. Contact with the third rail is by means of a sliding shoe on the train. Since iron is a bad conductor of electricity, the current is conveyed to the third rail, and returned from the running rail, by means of "feeders," copper cables connected to them at intervals, and to the dynamos at the generating station.

The disadvantage of the third rail is that, if any but a very low voltage be used, there is danger of fatal shock to persons touching it. It is therefore unsuitable for use in streets, and this led to the development of the *overhead or trolley system*. In this, the current is conveyed by a bare phosphor-bronze wire suspended above the track, contact being made with it either by a sliding bow, suitable for fast traffic, or, more commonly, by a "trolley pole," a long, flexible arm having a small

grooved wheel at the end which runs on the overhead wire.

In large networks, the current is conveyed to various parts of the system at a high voltage, for the sake of economy in transmission (*q.v.*), and this is now invariably 3-phase alternating current. For many reasons, there are great advantages attaching to the use of direct current to operate the motors on the train; but alternating current can be rectified into direct current only by means requiring skilled attention, whereas high-voltage alternating current can be transformed down to one of low voltage by a "static" transformer (*q.v.*), requiring no attention. When direct current is used, transformation is either by motor generators (see DYNAMOS AND MOTORS) or by *rectifiers* (*q.v.*). One of the latest developments is to employ rectifiers on the locomotives themselves, since these are much lighter in weight than motor generators of the same output.

In city tramways, the motors are invariably fixed to the car axle, the driver being stationed at the front of the car. On the Continent, trailer without motors are employed to increase the capacity of the wagon as required, but in England the practice is to build larger single cars. For suburban and main-line railways, two systems are in vogue, in one of which a separate locomotive is employed drawing ordinary carriages, whilst in the other the motors are distributed along the train, being controlled from a cabin in front of the first coach. The great advantage of electric traction lies in the rapid acceleration possible, thus effecting a great saving of time when frequent stops are made. The acceleration which can be given to a vehicle running on rails by driving the wheels depends upon the friction between the wheels and the rail, and this in turn depends upon the axle load. With a large number of separate motors, the power is applied at a great many points, and a rapid acceleration can be obtained without slipping of the wheels. When the locomotive system

is employed the weight of the passengers and passenger cars is not available to help adhesion of the wheels to the rails and hence slipping is liable to occur.

Another advantage of electric traction is that it does not pollute the air and hence renders underground suburban traffic more agreeable. Neither of the advantages we have mentioned is applicable to long distance traffic for which electricity presents both advantages and disadvantages. The advantages lie chiefly in a lessening of the operating costs on the trains themselves (no fireman being required) and in the reduced operating costs in maintenance and service at termini. Also the reduction of the smoke nuisance in cities is to be remembered though there are several systems of traction employing both coal and oil to generate steam which also eliminate smoke. The disadvantages of long distance electrification are numerous. Electricity cannot conveniently be stored and hence the generating station must be adequate to cope with the maximum load thrown upon it. When an electrified system is carrying a large number of trains simultaneously over most of the twenty-four hours the load on the generating station is fairly constant in a long-distance railway with fewer trains this is not the case. Also electric transmission of power although efficient cannot be accomplished without loss both actual loss of power and loss through the interest upon the heavy capital involved in laying the electric mains and conductors. These disadvantages can be mitigated when the country is covered with an electric grid or network of transmission lines fed with current at various points where generation is cheap and the railway system is connected to this grid at intervals. The railway load then will be generally a small fraction of the total load and its fluctuations will not seriously affect the cost of supply.

A further disadvantage remains namely the risk attaching to break

down of the supply either owing to accident (which becomes less and less likely) or to civil or military disturbance.

Great efforts have been made to operate electric vehicles economically by means of storage batteries but after a short period of vogue enjoyed by small electric runabouts in large cities no further success has been obtained. The chief reason is the great weight of the battery and its short life. Also the internal-combustion engine in spite of its inherent disadvantages has received so much attention from inventors and designers as almost to overcome its chief defects and to give it a commanding position in this field. Many petrol electric vehicles of extreme ingenuity have been successfully run the principle of these being the generation on the vehicle of electric current by means of a petrol motor and dynamo and the drive of the vehicle being effected by electric motors. This enables the petrol motor to run at fairly constant speed and the whole operation of the vehicle is smoother but the extra cost and weight has led to their abandonment. Diesel electric locomotives have been built and run successfully on railways but it is doubtful whether for long-distance traffic the direct drive of the Diesel motor is not preferable.

In a few places electric railways in which the cars run suspended from an overhead rail or cable have been used for passenger traffic and they are much used for the conveyance of minerals and other goods (*see ROPEWAYS*). The famous Bremen Elberfeld line is built so that the cars are suspended from a single rail which follows the centre of a river and is supported at intervals by steel supports from either bank.

Electrification. The invention of the electric motor by an American scientist Henry in 183 following on the pioneer work of Faraday made available a new source of industrial power as an alternative to steam and

later, to internal combustion. It was 50 years, however, before the invention was sufficiently perfected to be put

are able to generate electricity by this means, and so make themselves more or less independent of coal.

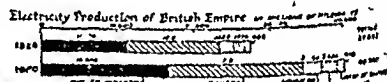
Sweden, Italy, Switzerland, France, and Germany were able to proceed rapidly on these lines, and in the United States large stretches of railway have been electrified. In 1929 there were *c* 6500 m of electrified route in the world, or rather under 1 per cent of the total railway mileage.

Meanwhile, the introduction of electric lighting (1880), of the telegraph (1878), and of the first experiments in applying electric power to industry, encouraged systematic generation.

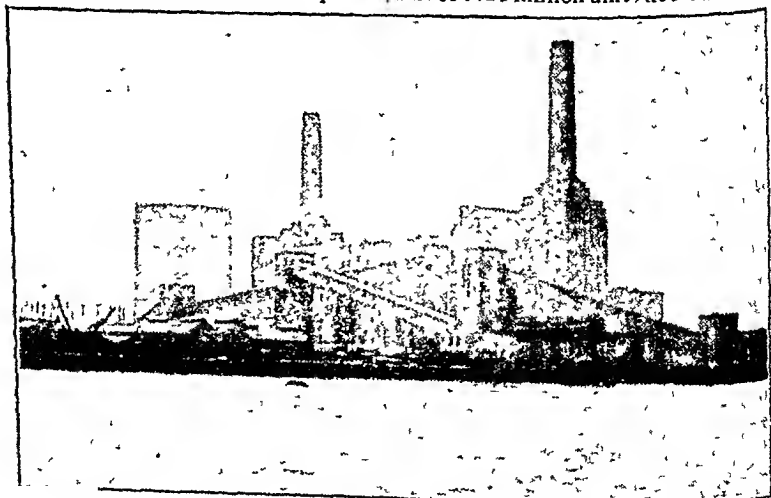
In 1906 generating plants in the United Kingdom had a capacity of a million kilowatts, and sold over 500 million units of electricity. In 1920, 476 generating stations had a

to practical use. Electric trams were introduced at the Paris Exhibition of 1881, and in the following year were experimentally used in Leytonstone. The work of Siemens rapidly increased the efficiency of electric traction, and in 1890 the City and South London Railway, which used electric locomotives exclusively, was opened. The whole of the Underground Railways of London were adapted to this form of power, and many suburban lines followed suit. In 1932 there were 650 m of electrified route in Great Britain, of which nearly half were operated by the Southern Railway.

In England, 90 per cent of the electricity used is generated by steam turbo-alternators from coal, but other countries with abundant water-power



capacity of 4½ million kilowatts and a sale of 572½ million units at *c* 2d a unit.



Battersea Power Station

In 1906 the Central Electricity Board was instituted by Act of Parliament with power to plan and operate a national grid system of high tension electric transmission lines. Nine schemes covering various parts of England and Scotland were prepared and up to 1933 the Board had borrowed £44 millions for their realisation.

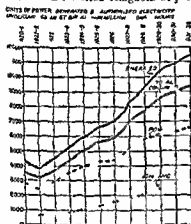
A tremendous increase in industrial electrification has followed the inauguration of this policy and the output has risen from 7000 million units in 1906 to 11 500 million units in 1931. Even so the United Kingdom at present

electrical energy and the converse process namely the conversion of electrical energy into chemical energy was observed almost immediately. Thus if a current of electricity is passed through water between platinum electrodes oxygen is given off at one pole and hydrogen at the other. The oxygen and hydrogen thus separated can be caused to reunite with the emission of heat and formation of water the heat thus emitted represents the energy of chemical separation of the hydrogen and oxygen and this again was obviously derived from the electric current which separated them.

According to Faraday's Law a certain quantity of electricity always liberates a definite quantity of any chemical substance from a liquid and the quantities of different substances liberated are in proportion to their chemical equivalent (i.e. atomic weight divided by valency see CHEMISTRY). This indicates that a given weight of given material is always associated with the same quantity of electricity and we are led to the idea that the material exists in the liquid not as part of a neutral atom or molecule but in the form of a charged ion. It should be added that we now know the total number of atoms which go to make up a gramme of hydrogen and also the quantity of electricity necessary to liberate it (its electrochemical equivalent). If we divide the second by the first we find that the resultant atomic charge of electricity is exactly the charge of the electron.

Though far from being an insulator pure water is a poor conductor of electricity but when acids alkalis or salts are dissolved in it the solution conducts the current very much better. The explanation of this fact and many others is given by electrolytic dissociation. According to this hypothesis the purest water is dissociated to a very slight extent into the ions

OH^- and H^+ these are charged electric



generates only 6½ per cent of the world-output of electricity standing third after the United States (45 per cent) and Germany (11½ per cent).

Electro-chemistry The fundamental discovery in electro-chemistry was made by Galvani in 1781 when he found that frogs legs severed from the animal contracted when touched at different points by two pieces of different metals which also touched one another. In 1799 Volta announced his construction as a result of following up Galvani's work of the first electric battery. It was soon recognised that the electric battery represents the conversion of chemical energy into



*Invisible vampire L'Éternelle Luxure
Sur la Grande Cité convoite sa pâture*

GARGOYLE THE STRYGE OF NOTRE DAME, PARIS
(From the etching by Méryon)

tions. We find that many salts are largely dissociated in ordinary dilute solution but that only in extreme dilution is dissociation nearly complete. In decinormal solution (see ANALYTICAL CHEMISTRY) the mineral acids are nearly 93 per cent. dissociated the caustic alkalis & 85 per cent. alkali salts of mineral acids about the same while the salts of metals such as copper and zinc are less than half dissociated.

Pure water is dissociated to a very slight but measurable degree the concentration of the ions being $\approx 10^{-7}$ normal. Fused salts appear to be highly ionised though this can only be inferred from their excellent conductivity, no method of measuring the degree of ionisation being known.

We now have to consider what happens at an electrode. The simplest case is where we have an electrode made of the same metal as that present as ions in solution. The passage of current in one sense results in metal going into solution forming ions while passage of current in the other sense results in metal being deposited. A definite potential difference exists between the metal and the solution compared by Nernst to that existing at the surface of a liquid evaporating or of a solid dissolving in a liquid. He supposed that the metal has a tendency to form ions that is for its atoms to pass into the liquid deficient in one or more electron in other words as positively charged ions. This cannot go far under normal conditions because the electrons left behind in the metal tend to attract the ions back again. We have to imagine a state of affairs consisting in the same kind of kinetic balance (see KINETIC THEORY OF MATTER) which exists in the case of vapour pressure and solubility.

Looked at from the electrical point of view this potential difference known as the Nernst electrode potential (which may be in either direction) represents electrical energy gained or lost every time a certain

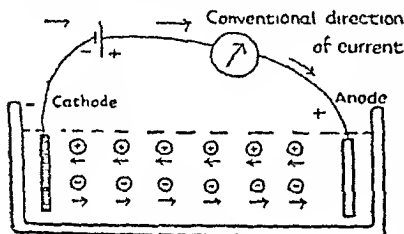
quantity of electricity passes across from the electrode to the solution or *vice versa*. Imagine a cell made up as in the Fig. in which we have a vessel divided into two parts by a porous partition on the one side we have a solution of copper sulphate and on the other side of zinc sulphate. If we pass a current through this cell from the copper to the zinc or *vice versa* the effect is that at one electrode copper goes into solution or is deposited and at the other zinc is deposited or goes into solution as the case may be. The result is that we exchange metallic copper for metallic zinc or *vice versa*. Whereas zinc dissolves very readily in acids with evolution of heat and copper does not dissolve in them at all it is obvious that when we pass the current in such a direction as to send copper into solution and take zinc out we shall have to do electrical work while in the other direction the cell will tend to help the current. This is in fact the well known Daniell cell. It can serve as an accumulator also though for reasons which we cannot here discuss it is in practice unsuitable for this purpose.

An important conception is that of a reversible electrode. In general terms this is an electrode at which the current can pass either way (to a limited degree) without upsetting the condition upon which the electrode potential depends. The simplest case is that of a metal in contact with the solution of one of its salts and with crystals of the same salt the solution therefore being saturated. If the current passes so as to deposit metal the crystals supply the amount withdrawn from solution, and conversely if the current is passed so as to cause metal to dissolve salt crystallises out.

It is unfortunate that in discussing this subject two terminologies are used. As we have explained the Nernst potential results from a balance of forces the metal striving to form ions and the ions striving to deposit themselves on the metal. The result is that the metal may sometimes be

ally, the hydrogen with a single positive charge, the hydroxyl with a single negative charge. All acids, alkalis, and salts are dissociated to a greater or lesser extent when dissolved (and also when fused) in a similar manner, thus common salt is dissociated into sodium ions and chlorine ions, copper sulphate (CuSO_4) into copper ions and SO_4 ions, and so on.

Imagine a glass trough filled with a salt solution and having at each end an electrode. This is connected to a



⊙ Positive ion Cation

⊗ Negative ion Anion

Diagram showing the Effect of a Current passing through a Salt Solution.

source of current through an ammeter which indicates the current passing. We know that the amount of electricity passing through each part of the circuit is the same, and we also know that this current in the metal is the motion of the fundamental negative atoms of electricity or electrons (see ELECTRICITY). In the glass trough, however, this is no longer the case. The current here is carried by two streams of ions moving in opposite directions. These two streams do not move at the same rate, because the resistance offered by the liquid to the motion of, e.g., a chlorine ion will not be the same as that offered to the motion of a sodium ion, the driving force in the two cases being equal and opposite. The total current is given by the sum of the two streams, the stream of positively charged ions, "cations" as they are called, being equivalent to an equal stream of

negatively charged "anions" in the opposite direction. At the electrodes, the ions are discharged. For instance, if the dissolved salt is cupric chloride (CuCl_2), we have copper liberated on the negative pole and chlorine gas on the positive, in equivalent amounts. Some people are puzzled by the fact that the ions are liberated in electrically equivalent numbers at the anode and cathode, and yet move towards these two poles at different rates. What happens is that the dissolved salt concentrates around that electrode towards which the corresponding ion moves the faster. The velocity of the ions under a given voltage can easily be determined, but in practice what are called "transport numbers" are more useful. These are stated for a given salt dissolved in water to a given strength. The transport number is defined as the ratio of the equivalent of 1 ion transferred to the corresponding electrode, to the total equivalent of ions transferred in both directions. The sum of the transport numbers for the 2 ions of any salt is equal to unity.

Ions migrate with extreme slowness; thus, in an ordinary copper plating bath, they are moving at a speed of the order of $\frac{1}{100}$ millimetre per second.

It will be understood that the conductivity of a solution (see ELECTRICAL MEASURING INSTRUMENTS) will vary with the number of ions present and the speed at which they move. Taking the latter question first, the resistance to the motion of an ion is that due to the viscosity of water (see VISCOSITY). It is governed by the same law, "Stokes's Law" (ηv), which determined the rate at which fine dust particles fall in air or water under their own weight. Hence, since the viscosity of water decreases rapidly as the temperature rises, the conductivity of salt solutions increases very rapidly as the temperature rises. Taking care to avoid this source of error, we can then investigate to what extent to which any given salt dissolves in water is broken up into ions, measuring the conductivity of so

rapidly enough to compensate for changes in concentration though such electrodes are usually called non-polarisable. A non-reversible electrode on the other hand such as a carbon electrode at which hydrogen is being evolved has certain special characteristics. Thus a pair of carbon electrodes in say hydrochloric acid are both polarisable when a current is passed between them. On one we get gaseous hydrogen on the other gaseous chlorine; carbon does not pass into solution as ions. The combination opposes a very considerable electro-motive force to the passage of a current. We find in fact that we can get hardly any current at all to pass unless we apply nearly $1\frac{1}{2}$ volts and if we suddenly break this current and measure the voltage between the two carbons we find that it is $c. 1$ volt.

A case of this kind represents the combined effect of two separate phenomena. In the first place an un-attackable electrode such as carbon or platinum acquires the Nernst potential proper to the substance liberated thereat. When it actually dissolves the substance as platinum dissolves oxygen and hydrogen we can measure the Nernst potential of such a substance which cannot be obtained in the form of a solid or liquid conducting electrode. If we avoid taking excessive current in the course of our measurements of say a polarised platinum electrode or keep it well supplied with gaseous hydrogen we get a means of measuring the concentration of hydrogen ions in a solution which is of the highest practical importance. On the other hand if the substance the ion of which is discharged at the electrode is soluble in water as in chlorine for example we also get a reversible electrode.

When we measure these electrode potentials and check them with other measurements of ion concentration and electrode potential we find that the voltage required to generate hydrogen gas on an electrode is greater than the hydrogen electrode potential.

The excess is called the over voltage; the theoretical explanation of its production is exceedingly doubtful even at the present time but it is of great practical importance. The electrolysis of dilute alkali or acid for instance with production of hydrogen and oxygen gases is a technical process of the greatest importance (see ALKALI).

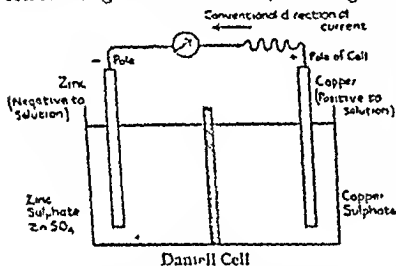
We have now to consider the fact that in electrolysis we very frequently have taking place what are called electrode reactions. For instance if we electrolyse a solution of sodium sulphate we find that the products are chiefly hydrogen and oxygen though a little ozone, hydrogen peroxide and persulphuric acid may be formed.

The ions in solution are Na^+ and SO_4^- . The Na^+ ions on being discharged become ordinary metallic sodium which is not stable in contact with water but forms sodium hydrate and hydrogen. The liquid around the cathode therefore becomes alkaline. The SO_4^- ions when discharged represent no known stable chemical substance and may be supposed to break up into oxygen which appears and sulphur trioxide which instantly combines with water to form sulphuric acid. At the electrodes in this case we have nascent hydrogen and oxygen in a state in which both gases possess abnormal chemical activity and if substances which can be oxidised or reduced are present in solution such oxidation or reduction will most likely take place. The industrial applications of electrolytic oxidation and reduction are mainly confined to organic bodies and increasing use is being made of such reactions as the reduction of nitrobenzene to aniline. Further information will be found in the article ELECTRO-CHEMISTRY TECHNICAL.

The ionic hypothesis or what is generally called the dissociation theory has been of the greatest assistance not only in electro-chemistry but also in pure chemistry where many otherwise inexplicable phenomena, especially

Electro-chemistry

electrically positive towards the solution, as is the case with metals such as gold, mercury, silver, and copper, which are readily obtained in the metallic state, while in other cases the metal is negative towards the solution, as is the case with the base metals zinc, aluminium, etc. In every case, reducing the ions in solution tends to make the metal more negative or less positive, and the opposite effect is produced by increasing the ion. It is much the best plan to speak of the potential of a metal in the above terms, but it should be noted that the actual tendency of the current to flow across the electrode is a passage of electrons from the solution to the electrode if negative, since the metal tends to go into solution, leaving an



Daniell Cell

electron. As explained more fully in the article **ELECTRICITY**, the convention has been adopted of regarding the electric current flowing through the outer circuit as flowing from positive to negative. The actual electron stream in a metal flows the opposite way.

If we study the accompanying diagram of the Daniell cell, we shall see what all this means. The arrows indicate the *conventional* direction of current flow. The cell would be marked by the manufacturer with a positive sign on the copper terminal and a negative on the zinc terminal, the current thus flowing from the copper to the zinc in the conventional sense, the electron stream being in the opposite direction. The zinc as a base metal is at a negative potential towards the solution, so we see that at

this junction there is an electromotive force propelling the *conventional* current in the actual direction which it is taking. The copper again is positive towards the solution, and hence here again there is an electromotive force tending to help the current. We see that both electrodes are helping the current, also, the weaker in zinc and the stronger in copper, the higher the electro-motive force of the cell.

A cell, made up of two copper electrodes dipping into strong and weak copper-sulphate solutions respectively, also will tend to deliver a current, the direction of this being such as to deposit copper on the electrode immersed in the strong solution and to cause the electrode immersed in the weak solution to go into solution. This is called a concentration cell. If we start with two copper plates immersed in copper sulphate solution, as in a plating bath, and pass a current of any ordinary value, we shall deposit copper rapidly on the cathode, and cause it to dissolve into the solution from the anode. In view of the extreme slowness with which ions move the copper ions formed at the anode will be carried away from there by the current only to an inconsiderable extent, while copper deposited at the cathode will also be supplied to a minute extent by the migration of ions. Such a plating bath can function only if the liquid is in rapid circulation, though even strong circulation cannot sufficiently affect the liquid immediately in contact with the two electrodes entirely to eliminate the formation of a concentration cell. The electromotive force thus set up opposes the current which is being passed through the cell, and we have what is known as concentration "polarisation".

"Electrolytic polarisation" is a term employed to denote the set up by passage of a current at the electrode of an electro-motive force tending to oppose the current. Electrodes are polarisable, for every reversible electrode cannot function

rapidly enough to compensate for changes in concentration though such electrodes are usually called non polarisable. A non reversible electrode on the other hand such as a carbon electrode at which hydrogen is being evolved has certain special characteristics. Thus a pair of carbon electrodes in say hydrochloric acid are both polarisable when a current is passed between them. On one we get gaseous hydrogen on the other gaseous chlorine. Carbon does not pass into solution as ions. The combination opposes a very considerable electromotive force to the passage of a current. We find in fact that we can get hardly any current at all to pass unless we apply nearly 1½ volts and if we suddenly break this current and measure the voltage between the two carbons we find that it is a 1 volt.

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those connected with reactions in aqueous solution, have been cleared up. Water is almost unique in its power of dissolving substances and ionising them, only a few other liquids, such as liquefied ammonia, pyridine, and alcohol, show any trace of these powers. Hence it is that reactions take place so readily in aqueous solution, such reactions, in the case of acids, bases, and salts, being reactions of the ions rather than of the salts themselves. For instance, when a strong acid neutralises a strong alkali, both being dissolved in water, a considerable amount of heat is generated and this amount of heat is found to be approximately the same for the same equivalent amounts of any acid or base. Now the acid is dissociated into its ions, say H^+ and Cl^- , and the base is also dissociated, say into Na^+ and OH^- . The product of reaction is NaCl , dissociated into Na^+ and Cl^- . The actual reaction thus simply consists in the combination of H^+ and OH^- to form H_2O .

We now have to consider another important matter connected with the properties of water. As explained in the article, KINETIC THEORY OF MATTER, the law of mass action requires the product of the concentrations of the hydrogen and hydroxyl (OH^-) ions in water to be constant. Consequently, in an acid solution, there being a large excess of hydrogen ions, the concentration of hydroxyl ions is reduced, and in an alkaline solution with a large excess of hydroxyl ions, the concentration of the hydrogen ions is likewise reduced.

We call a strong acid or a strong base one which is very highly dissociated in solution. Thus, sulphuric acid is a strong acid, an equivalent quantity of acetic acid (vinegar), dissolved in water, has much less strongly acid properties. If we dissolve sodium acetate in water this tends, like any sodium salt, to dissociate strongly,

but the resulting ions of acetic acid immediately seize upon hydrogen ions from the water, forming undissociated acetic acid. This results in the formation of an excess of OH^- ions, and the solution becomes slightly alkaline. This process is called "hydrolysis." Looked at from a purely chemical point of view, water appears to behave as an acid or an alkali according to circumstances, turning out a weak alkali or a weak acid from its compound. The above facts are very important in connection with volumetric analysis (see CHEMICAL ANALYSIS).

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Electro-chemistry, Technical. The subject of technical electro-chemistry falls into three main divisions: firstly, that of aqueous solutions, secondly, the electrolysis of fused salts, and thirdly, the application of various types of electric furnace.

Aqueous Solution. The simplest case in which the electrolysis of an aqueous solution is technically applied is the refining of metal. All copper for electrical purposes is refined by depositing it from solution in copper sulphate, the impure copper being used as anode. The only process taking place in the cell is thus the transference of the copper from the anode to the cathode. Hence the consumption of electrical energy is comparatively small, furthermore, the precious metals, gold, platinum, and silver, present as impurities, do not dissolve, but form a mud which collects at the bottom of the cell and is worked up for all the valuable material contained in it. In the Raritan refinery the cells are of wood lined with lead, 9 ft 10 in \times 2 ft 10 in \times 3 ft 8 in. In a tank of this size there are 28 anodes and 29 cathodes, connected in parallel, and several hundred such tanks are then connected in series. It is usual to work at a temperature of c 60° C, whereby a better and firmer deposit of copper is obtained and the resistance of the

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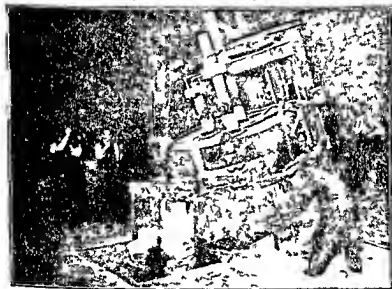
in Italy depend upon moving arcs while the Schönheerr process at Saarheim and Christiansand and the Schönheerr Hessberger process utilise moving gas. The nitric oxide so formed is then converted into fertiliser. It is probable that these electrical methods of fixing nitrogen will be unable to compete with the Haber ammonia process (see AMMONIA).

The electric furnace is of three fundamental types. The first type is the arc

nated by exposing them to an alternating magnetic field.

The arc furnace in many forms has found extensive use in the smelting of iron and steel (q.v.) and without it the production of modern high grade steels would be impossible. The supreme virtue of the furnace lies in the absence of all contamination of the charge.

Heat may by resistance is made use of in the production of calcium carbide, calcium cyanamide, phosphorus and



Electr. Furnace Pouring

furnace in which material to be heated to a high temperature is brought into a confined space in which an electric arc (7 v) is also formed. The second type derives its heat from the passage of an electric current through a solid or liquid resistance, this material often being the charge itself. The third type is the induction furnace in which either the charge itself or the crucible in which it is contained must be a good electrical conductor. In either of them a strong eddy current is gener-

graphite each of which is the subject of a special article.

The induction furnace has long been employed for iron and steel work but its use has now been extended to many other metals. The original induction furnace operated at ordinary supply frequencies (50-60) the furnace then consisting of a transformer primary priming the necessary iron and a short-circuited secondary in the form of an open trough. In this the material to be heated was placed. The

An increasingly important application of electrolysis is the production of oxygen and hydrogen by electrolysis of acids or alkalis. The process is worked at electricity-supply stations during periods of light load and the gases are stored under pressure in steel cylinders. It is possible to work at high pressure, thus eliminating the need for a compression plant. The cells are simple in principle, consisting merely of two non-attackable electrodes, generally of nickel, with caustic soda as electrolyte.

The electrolysis of fused salts is another branch of the subject. Its most important application is the production of aluminium, the use of which is increasing rapidly. The process is based on the fact that alumina (Al_2O_3) readily dissolves in molten mixed fluorides of aluminium and alkali, the mineral cryolite (Na_3AlF_6) being used. This melts at $c 1000^\circ\text{C}$. Alumina from bauxite is first treated with caustic soda under pressure, which dissolves the aluminium, forming a super-saturated solution. The caustic soda is then diluted with the addition of some precipitated aluminium hydrate, whereupon nearly all the aluminium hydrate is thrown down. The caustic soda is then concentrated again and used to treat bauxite. The cell used for electrolysis is a large shallow rectangular iron box, lined with carbon. The current is led to the bottom of this box, the anodes being large carbon blocks hung from busbars above the cell. While working, the mass is covered by a solid crust, except just round the electrodes. The aluminium metal collects at the bottom of the cell, and is tapped or lidded off every 2 or 3 days. Steady advance has been made in the purity of the metal produced, a point of value as affecting its durability.

Finally we come to processes which are hardly electro-chemical at all, since the effects produced are due mainly or entirely to the heating effect of the electric current and not to its chemical effect. As a transition case

we may take the oxidation of atmospheric nitrogen produced by producing an electric arc in air. The existence of life depends upon the availability of chemically combined nitrogen, the nitrogen present as an element in the air being serviceable as food only to a few bacteria (*qv*). The nitrogen in the soil is exhausted more rapidly than it is replaced by cultivation, and consequently the use of nitrogenous manures has become more and more general, the prime source of these until the World War being the deposits of sodium nitrate found in Chile. The fruitful experiments of Cavendish had shown that nitrogen and oxygen could be caused to combine by means of an electric spark, and from $c 1895$ onwards continual experiments were made until in the early years of this century technical success began to be obtained. This depends fundamentally upon the fact that nitric oxide, NO , which is the primary product, decomposes again unless the gas which has been exposed to the discharge is cooled very rapidly. It is supposed that a mixture of nitrogen, oxygen, and nitric oxide has a different equilibrium composition at every temperature, and that its proportion of nitric oxide in relation to nitrogen and oxygen increases rapidly with increase of temperature. If the mixture of gases is raised to a high temperature we get, let us say, at 4000°C , 8 per cent by volume of the gas. If the mixture is cooled slowly, this drops to less than 1 per cent. at 2000° . If, on the other hand, the gas is cooled quickly, there is no time for decomposition to occur.

The application of this principle requires, therefore, rapid relative motion of arc and gas acted upon. The gas may move comparatively slowly through the apparatus and the arc move rapidly, or the gas may pass rapidly through a stationary arc. The Birkeland-Eyde process, operated at Notodden, Saheim, and Zunftoss, the Moosick-Kowalski process in Switzerland, and the Pauling process

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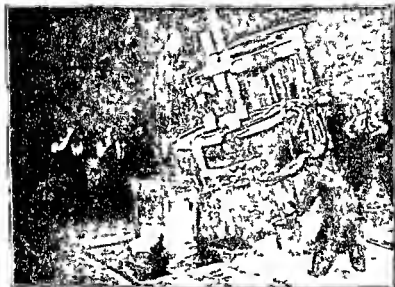
Italy depend upon moving arcs while the Schönher process at Saahem and Christiansand and the Schönher Hessberger process utilize moving gas. The nitric oxide so formed is then converted into fertilizer. It is probable that these electrical methods of fixing nitrogen will be unable to compete with the Haber ammonia process (see AMMONIA).

The electric furnace is of three fundamental types. The first type is the arc

ated by exposing them to an alternating magnetic field.

The arc furnace in many forms has found extensive use in the smelting of iron and steel (q.v.) and without it the production of modern high grade steels would be impossible. The supreme virtue of the furnace lies in the absence of all contamination of the charge.

Heating by resistance is made use of in the production of calcium carbide, calcium cyanamid, phosphorus, and



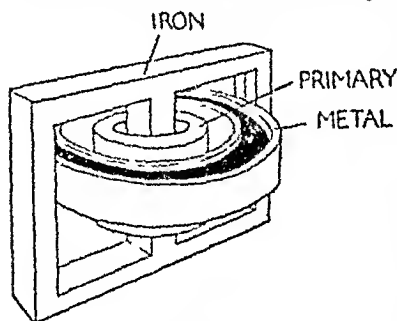
Electric Furnace Pouring

furnace in which material to be heated to a high temperature is brought into a confined space in which an electric arc (q.v.) is also formed. The second type derives its heat from the passage of an electric current through a solid or liquid resistance; this material often being the charge itself. The third type is the induction furnace in which either the charge itself or the crucible in which it is contained must be a good electrical conductor. In either of them a strong eddy current is gener-

graphite, each of which is the subject of a special article.

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diagram shows the simplest type of furnace design, but modern furnaces are more complex. The most modern development is the ironless high-



Induction furnace

frequency induction furnace. Current induced in a piece of metal placed in an alternating magnetic field increases rapidly with increase of frequency. The Northrop furnace consists simply of a solenoid fed with high-frequency current, and the metal to be heated is placed in a crucible within the solenoid. It may be heated rapidly to almost any temperature, up to the limit that the crucible will stand. The application of this method at once led to rapid advance in our knowledge of the rarer metallic elements more difficult to obtain, but it is now being applied for melting common metals and alloys.

Electrode, see BATTERY

Electrolysis, see ELECTRO-CHEMISTRY.

Electro-magnetic Induction and Electro-magnetism It is explained in the articles ATOM and ELECTRICITY that the fundamental unit of all material phenomena is the electric charge. The free negative electric charge is the electron, and all our electrical phenomena of everyday experience are due to the motion of electrons, an electric current in a metal being the flow of electrons. When an electron is moving at a uniform speed, it is surrounded by lines of magnetic

force in the form of closed circles. When a current is flowing in a wire, the wire is therefore surrounded by a circular magnetic field which will act upon a magnetic needle in its neighbourhood. The diagram shows the direction of these lines of force and the way in which they act upon a magnetic field. The current direction is given in the conventional sense, that is, as flowing from positive to negative. The flow of the electrons, which are negative charges, is in the opposite direction. The magnetic needle has its ends labelled N and S. N is the N-seeking pole, S the S-seeking pole. The action upon the magnetic needle is such as to cause it to turn round its pivot in the direction shown by the arrow. This effect is easily illustrated by passing a vertical wire through a piece of card upon which iron filings are sprinkled. When the card is tipped the filings arrange themselves in circles round the wire, that is, along

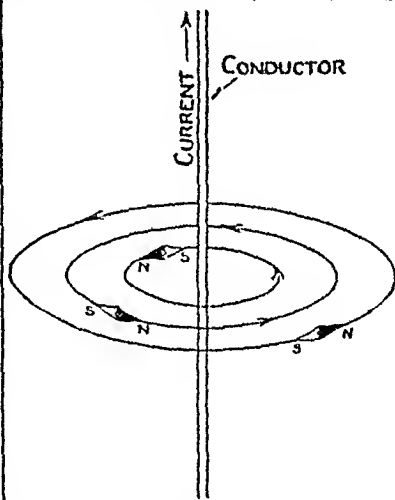


FIG 1

the lines of force. A striking demonstration of this endless character of magnetic lines of force is given by an apparatus due to Faraday. Two bar

magnets are joined together in the middle by a bridge carrying a pivot in its centre this pivot resting in a cup containing a drop of mercury on the top of a column from the bridge a wire passes horizontally and then dips into a circular trough filled with mercury and concentric with the column. An electric current is sent up through the column and through the bridge to the trough. It creates around the column a set of circular lines of magnetic force which affect the lower poles of the magnet strongly but the upper poles only weakly the result being that the magnets rotate continuously in the direction shown by the arrow as long as the current is passed.

The force exerted on a magnetic pole by a very short piece of a current is inversely proportional to the square of the distance of the pole from it and directly proportional to the strength of the current but in a long straight wire it varies inversely as the distance from the wire. This force varies according to the permeability of the intervening medium a quantity denoted by the symbol μ . If the unit of electric current is defined by the force which it

divided by the distance away from the wire. It is much more difficult to calculate the strength of the field inside a solenoid but one very simple formula

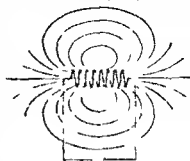


FIG. 1

is worth recording namely that in the middle of a long straight solenoid having N turns of wire per centimetre the field strength is $4\pi Ni$.

The constant μ is in rare instances smaller than 1 again in a few cases it is very much greater than 1. If an electric current be surrounded by iron the magnetic field (produced of course in the iron) may easily be over 1000 times the field that would exist if air surrounded the wire.

We have said that magnetic lines are endless or closed curves. For instance in the case of a solenoid the magnetic lines which are circles in the case of a straight wire form curves as shown in Fig. 1. We have said that the intensity of the magnetic field produced at any point varies with the medium according to the permeability exactly as in the case of electric lines of force (see ELECTRICITY). We measure field strength by the number of lines of force per unit area thus unit field which exerts unit force on unit pole has one line per unit of area. If we replace the air in our solenoid by an iron core we shall get in the iron thousands of times more lines than existed in the air. Our piece of iron has become a bar magnet and we can measure its pole

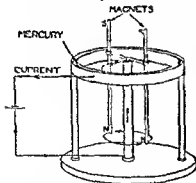


FIG. 2.—Faraday's Apparatus.

exerts upon unit pole taking into account the factor μ we find that the strength of the field H produced by a current i is equal to twice this current

strength We find a convenient expression in the "intensity of magnetisation," always represented by the letter I , and defined as the pole strength divided by the area of the cross-section of the iron The magnetic "susceptibility" is then defined as the ratio of the intensity of magnetisation to the strength of the magnetising field This magnetising field is that produced by the solenoid less the demagnetising field produced in the iron by the poles The latter can be eliminated by winding the solenoid upon a circular ring, in which case no poles are formed Finally, we use the letter B to denote what is called the magnetic induction in the iron, that is to say, the total

while further increase in the magnetising force produces less and less effect The intensity of magnetisation of the iron thus tends to a limit, which is called "saturation" Thus the simple conception of magnetic permeability with which we started, which is analogous to the dielectric constant (see ELECTRICITY) as a constant characteristic of a particular material, is no longer such when we are dealing with iron and similar substances It should be noted that in accordance with the above terminology, the permeability is equal to the ratio of the magnetic induction produced in the substance to the intensity of the magnetising field

Faraday himself expressed the properties of iron by saying that it had a greater conductivity for magnetic lines than air This peculiar way of regarding magnetic phenomena has also been developed by practical men in a set of terms copied from electric current The magnetic flux is regarded as produced by a "magnetomotive" force and opposed by a kind of resistance called the "reluctance" These terms are defined in such a way that a simple formula similar to Ohm's Law can be used magnetic flux equals magnetomotive force divided by reluctance Take the simple case of the "anchor" ring magnetised by a coil $H = 4\pi N_1/L$ where N_1 is the whole number of turns of the solenoid The magnetic flux

$$= BS = H\mu S = \frac{4\pi N_1^2}{L/\mu S}, \text{ if } S \text{ is the cross-section of the core Here } 4\pi N_1^2 \text{ is the magnetomotive force, and } L/\mu S \text{ the reluctance or magnetic resistance. } N_1 \text{ is the number of "ampere-turns"}$$

So

$$\text{magnetic flux} = \frac{\text{magnetomotive force}}{\text{reluctance}}$$

It is obvious that if a current exerts force upon a magnetic pole, a magnetic pole or field will exert force on a conductor, and that two electric conductors carrying current will exert

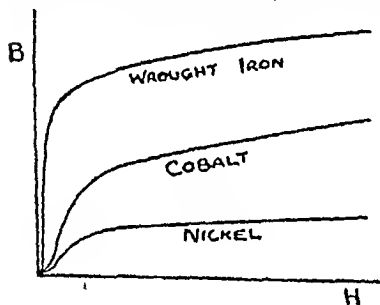


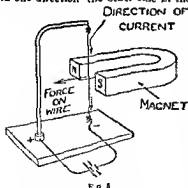
FIG 4

number of lines of force passing through it per unit area This is also called the magnetic flux per unit area

A fact of fundamental importance in practical application is that the susceptibility of iron and most other "ferromagnetic substances" (that is, substances having a large susceptibility) is not a simple constant of the material, but varies with the magnetising force This is usually expressed by curves deduced from experiment, in which either I or B is plotted against H We give such a set of curves for some ferromagnetic materials It will be seen that the iron is hardly more magnetisable than air when exposed to very low magnetising forces, but when the force is increased the iron suddenly becomes strongly magnetised,

force upon one another. The simplest case of this force is seen in the arrangement shown in Fig 5 in which a single copper wire is passed through an air gap in a magnet. We find that the wire is pushed in a direction at right angles to the magnetic lines. We speak of the direction of an electric current as from positive to negative in the same way we speak of the direction of a magnetic field as from N pole to S pole these are simple conventions. If we hold the left hand with thumb, forefinger and middle finger at right angles to one another with the forefinger pointing in the direction of the field and the middle finger in the direction of the current the thumb will point in the direction of the force exerted by the field upon the conductor. This force is proportional to the product of the induction, the current and the length of the conductor carrying it.

If a coil is suspended in a magnetic field it will turn so as to set itself at right angles to the direction of the field at which position the field exerts no force upon it. In any other position one side of the coil is urged in one direction the other side in the



opposite direction so that a twisting action is produced. This is an example of a general rule namely that an electric circuit if movable flexible

or extensible always moves so as to enclose the maximum possible number of lines of magnetic force whether

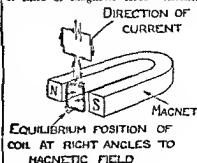


FIG 6

produced by itself or existing as a result of another agency.

The practical application of the above facts will be found in the articles ELECTRICAL MEASURING INSTRUMENTS DYNAMOS AND MOTORS ELECTRO MAGNETISM.

We now have to consider the phenomena announced to the Royal Society by Faraday on Nov 11 1831 phenomena of such importance that this date must be regarded as one of the most important in the history of the world. Faraday showed that an electro-motive force is set up in a conducting wire when it is moved at right angles to a magnetic field in other words in the same direction as that in which it would move if traversed by a current. If the wire is part of a closed circuit its motion therefore results in an induced current and the direction of this current is such as to oppose the motion of the wire that is to say if we produce this induced current by a battery let us say the wire would move in the opposite direction. We can regard these matters from another point of view. If we consider a closed circuit either complete in itself or part of a larger circuit we find that the electro-motive force induced in it when it is in the magnetic field is proportional at any moment to the rate of

change of the magnetic flux through the coil. But if now we take the special case of the ring wound with a coil (Fig 7), and wind upon the ring a second ("secondary") coil, we find that when the magnetising current in the first coil is started or stopped or varied, an electro-motive force is induced in the second coil, although its copper turns are not caused to "cut" magnetic lines, for no magnetic lines are produced by this arrangement outside the iron. The latter method of regarding the matter is the more general of the two. We find again, that if the induced electro-motive force is allowed to produce a current, the direction of this is such as to oppose the magnetising effect of the original current. Thus, if we start the

field produced by the circuit. The stronger this magnetic field, the greater the delay, if a battery is applied to the terminals of a large electro-magnet or transformer, the establishment of the current may take several seconds.

The converse of what we have said is that when the current in any circuit is interrupted, with the result that the magnetic lines passing through the circuit decrease, there is an induced electro-motive force both in the primary circuit, and in the secondary circuit, if any, tending to maintain the existent magnetic field and current.

The nature of these effects is best seen when we consider the way in which they are measured. Any circuit or part of a circuit is said to possess *self-induction* or *inductance*, and the unit for the measurement of this is called the Henry from the scientist of that name. It is the inductance of a circuit in which a change of current of 1 ampere per second produces an induced electro-motive force of 1 volt. This is usually denoted by the letter *L*. Another definition of it is simply given by saying that the total number of magnetic lines passing through the area enclosed by a circuit is given by the inductance of the circuit multiplied by the current.

The work done by the battery against the temporary back electro-motive force due to inductance is stored in the magnetic field, and when the circuit is again broken, it is released. A striking demonstration of this fact can be given by an arrangement in which a high-voltage lamp is momentarily lighted by means of a low-voltage battery. In parallel with the lamp is a coil containing an iron core, and connected to this double circuit is a small battery in series with a key. The circuit is made by the key for a few seconds; the lamp, of course, does not light up. When the circuit is broken, the energy stored in the magnetism given to the iron is re-

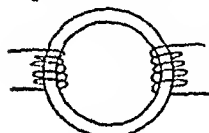


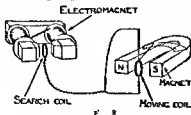
FIG 7

original current, the induced current tends to neutralise its magnetising effect on the iron. But since the induced current only exists while the state of magnetism is changing, the actual result is that the primary current, as it is called, is only temporarily checked as regards its magnetising effect, and the strength of it soon attains its full value.

Now let us consider the primary circuit. We have said that its magnetising effect is opposed by the current induced in the secondary circuit. But the primary circuit is in exactly the same position as the secondary circuit, for the magnetic flux passing through it also is changing. In it also, therefore, an electro-motive force must be induced, and this likewise opposes the current flowing in it. This would be the case even if the secondary circuit did not exist. The effect of this is that when a circuit of any kind whatever, containing a source of electro-motive force, such as a battery, is closed, the establishment of the full and final current calculated by Ohm's Law is delayed for a time owing to the opposing effect of the magnetic

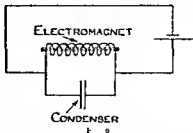
leased and a considerable current is passed through the lamp which flashes up for an instant.

There are various special cases of importance which we must now consider. The first of these is that of a small coil connected by flexible wires twisted together to a moving coil suspended between the poles of a magnet. If the first coil is placed in a magnetic field say between the poles of a powerful electro-magnet and then suddenly withdrawn some distance away or simply turned round in the field the total magnetic flux originally passing through it is reduced to zero in the first case made equal and opposite in the second. During the process an electro-motive force is generated in the coil and this causes a current to pass through it and through the suspended moving coil. This electro motive force will vary according to the speed with which the motion is carried out but the total quantity of electricity which flows around the circuit is always the same however the operation be performed. If the moving coil be undamped in its motion but provided with a spring control (see ELECTRIC MEASURING INSTRUMENTS) or if it be damped but not controlled its deflection (which is momentary) will measure the total quantity of electricity passed through it and therefore the strength of the magnetic field. This is what is called the search coil method of measuring magnetic field.



When a condenser (Electrolytic) is connected to a battery or other source of electro-motive force a current flows along both connecting wires to the

plates of the condenser until the latter is fully charged up when the current ceases. This is exactly the opposite effect from that obtained by connecting



a highly inductive piece of apparatus such as an electro magnet to a battery here the current starts at a low value and rises slowly to a final value. It is not difficult to see that by connecting both these pieces of apparatus at once to a battery we can arrange for the effect of one to neutralise that of the other so that the current starts immediately at its full value. This arrangement shows the converse peculiarity when the current is broken the high voltage spark which we should get with the magnet alone is missing. It is instructive to consider this from the energy point of view for at first sight it might seem to contradict what we said concerning the energy used up in magnetising the magnet. As a whole the arrangement shows no sign of a back electro motive force. The difficulty is easily explained as follows. When the final steady current is flowing none of it is going into the condenser which is an insulator the whole of it is passing through the coil of the magnet and the energy expended is entirely represented by heat. When at the start though the same current flows most of it is flowing into the condenser while the current in the magnet is slowly approaching its final value during this period the generation of heat takes place at a less rate none being generated in the condenser and the balance is represented by the energy flowing into the magnet. On

the current being broken, the electro-motive force generated in the magnet results in a charge being given through the condenser, which again discharges itself through the magnet winding. Taken as a whole, this arrangement may be regarded as a means by which self-induction and capacity neutralise one another's effect, and it is of great importance from this point of view in telegraphy and telephony, under which headings it will be further discussed. It has, however, another remarkable property, namely that of being capable of electrical oscillation. Instead of acting in the simple manner above described, each effect namely, the charging of the condenser and the magnetisation of the magnet, overshoots the mark, and we get an oscillation of the current in the magnet between two extreme values. It is this oscillation which is the starting-point of all methods of producing *electro-magnetic radiation*, as described in the article under that name.

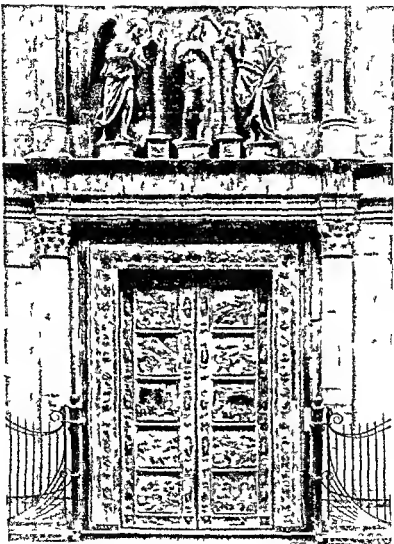
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Electro-magnetic Radiation. Under **ELECTRICITY** and **ELECTRO-MAGNETIC INDUCTION**, it is explained how a moving electric charge of any kind, and an electron in particular, produces a magnetic field in the form of circular lines of force around its path, an effect well known to us in the form of the steady magnetic field produced by a steady current of electrons flowing in a wire. We also know that when electrically charged bodies, such as electrons, are situated in a changing magnetic field, an electric force is exerted upon them, familiar to us as the current induced in a wire when it is exposed to a changing magnetic field. Maxwell, in 1860, published a view of these matters which has turned out to be one of the most fertile conceptions of modern science. He formulated two general laws: (1) that *every change in an electric field produces a magnetic field in the same place*, and (2) that

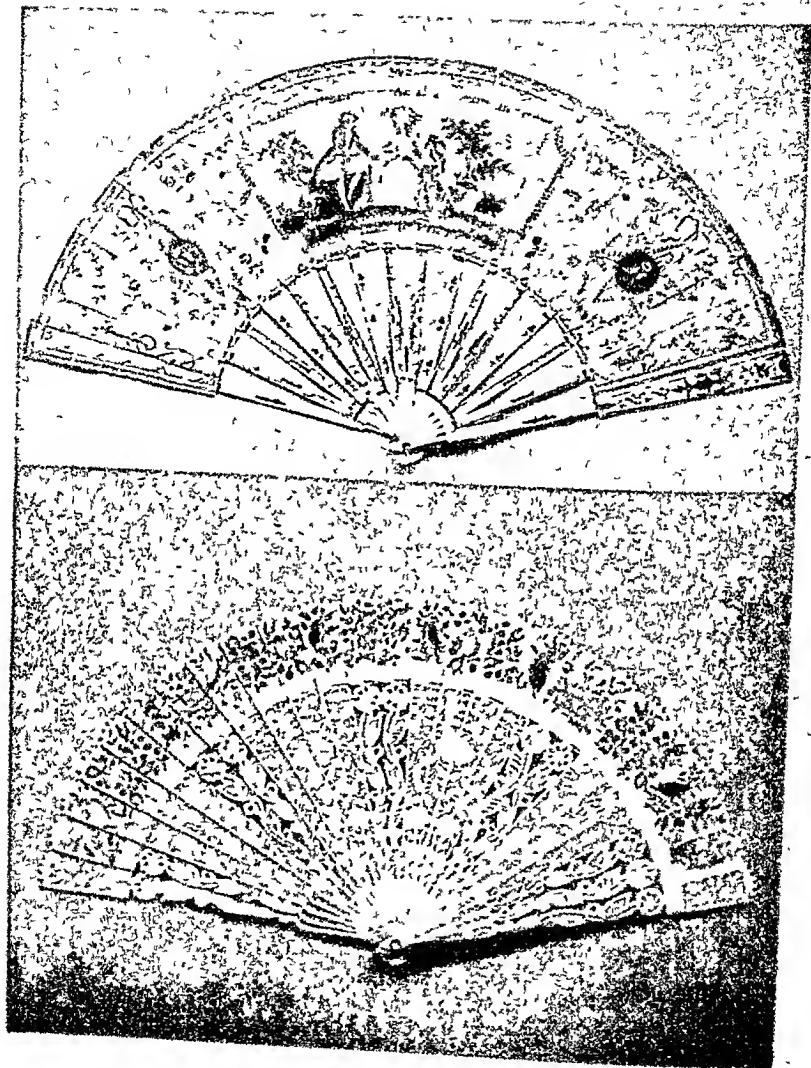
every change in a magnetic field produces an electric field.

As a result of Maxwell's mathematical investigation of the consequence of these laws, he found that any change in an electric field, together with the concomitant magnetic field, will be propagated into space at a finite speed, he was able to calculate this speed, and he found it to be the same as that of light. Maxwell's results show that a unit electric charge (see article on **ELECTRICITY**) moving at the speed of light would exert unit force upon unit magnetic pole at unit distance away from it.

When we initiate a current in a wire, we set up a magnetic field around it which finally extends throughout space. This is not set up immediately, as this would involve the magnetic lines travelling outwards from the conductor with infinite speed. It follows that the simple statement of the energy absorbed by a circuit in the setting up of a current and producing a magnetic field of given strength is not correct unless the current is set up very slowly. We find that if we take into account the fact that the magnetic field does not follow exactly the current in the wire, but lags behind it, an extra amount of energy will be given to the circuit by the battery. This energy is radiated away into space in the form of *electro-magnetic radiation*. To understand exactly the nature of this, let us imagine ourselves at a point through which such radiation is passing in the form of a train of waves. If we had sufficiently delicate instruments to detect electric and magnetic fields, we should find that the electric detector would show a rapid oscillation of the electric force in a certain direction, while the magnetic detector would show a similar and simultaneous oscillation of the magnetic force in a direction at right angles to the other. A wave in the sense here used is not comparable in nature to waves on water or sound waves in air. We mean simply that something changes, becoming greater and less alternately,



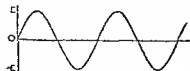
BAPTISTERY FLORENCE BRONZE DOOR
(By Lorenzo Ghiberti)



FANS (B) ENGLISH PAINTED SILK FAN
 (Second half of the 18th century)
 (C) CARVED AND PAINTED IVORY FAN
 (19th century)

at a given point and that as we go away from this point similar changes take place later.

If we represent the waves by a curve as in Fig 1 each point of the curve represents the disturbance (as it is usually called) which is travelling in the form of a wave. In the Fig any point on the curve above the line 0 (representing distance) may represent the strength of an electric or a magnetic field in one sign, while the point at an equal distance below the line represents a field of equal strength but opposite in sign. If the curve represents a wave on the surface of water the line 0 would then represent the level of the surface when it is undisturbed and points on the curve would represent the position of particles of water at some particular instant these particles oscillating to and fro above and below the average surface level. After the nature of electro-magnetic radiation was thoroughly understood efforts were made to explain it by supposing it to be an actual wave motion in a material substance which was called the ether. For a wave to pass through a material substance it is necessary that the substance should be elastic (see ELASTICITY). Further if this electric strain is really an elastic strain in a medium it can be demonstrated that this medium must be a solid and not a fluid. Knowing the amount of energy actually contained in a train of waves and applying this fact to our imaginary ether we find that it needs to be much more elastic than the hardest steel. The notion



F. & L.

that empty space should be filled with a medium of this kind is mentally repulsive and so far from being helpful it leads us nowhere. Many books

have been written in attempts to explain the nature of ether and in the article RELATIVITY the final outcome

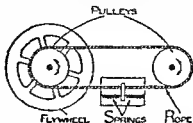


FIG 2

and abandonment of these attempts are explained.

The subject of electro magnetic radiation falls naturally into 2 parts. Waves of length down to a few tenths of an inch are generated by electric currents that is to say streams of electrons oscillating in metallic conductors but the shorter waves are generated by single electrons and their behaviour can be inferred only by very difficult and elaborate processes. The generation of the longer waves is comparatively simple and we shall consider them first.

Under the heading ELECTRO MAGNETIC INDUCTION self induction or inductance is described and it will be seen that the inductance of an electric circuit is analogous to a weighting of the electricity in the circuit. This may be illustrated by a rope representing electricity passing round two pulleys and a fly wheel attached to one of the pulleys representing the inductance. In the article ELECTRICITY the electric condenser is described but no analogy with a mechanical system is given. We must here make this deficiency good. If a condenser is connected to a supply of electric potential electric energy flows into it until it is charged to the same potential as the source. When we disconnect it the plates remain at this potential but if they are connected by a wire a current flows momentarily whereby the electric tension is discharged. A condenser

therefore, is analogous to a reservoir into which electricity can be compressed or to a spring compressed to an extent depending on the force applied

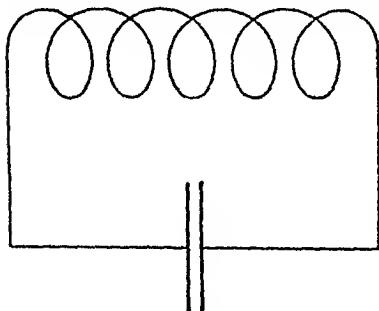


FIG 3

Reverting to our endless rope passing over a pulley, this represents a conducting circuit, because the electricity (the rope), can be set circulating by any electro-motive force (E M F), however small. If we fix the rope at one point, to represent insulating the circuit at that point, electricity can no longer circulate. But if we fix this point of the rope not rigidly, but to the centre of a spring, we can then push the rope some distance in one direction or the other. If the rope is in a box, as in the Fig, when we push it slightly one way, some of it enters the box on one side and a similar amount leaves the box on the other. This spring is analogous to a condenser connected to a self-inductance as in Fig 3. If we release the rope after pushing it against the spring, the whole arrangement will swing to and fro. The spring will restore the rope to its original position, but in doing so will have to revolve the fly-wheel, and when the rope is in its original middle position, the inertia of the fly-wheel will cause it to shoot beyond this and stretch the spring in the opposite direction. The rope will thus swing to and fro until friction brings it to rest. Exactly the same thing is true in the electrical case. If we charge the condenser and then connect it to the self-induction, the

electricity will surge to and fro with a certain frequency. It is obvious, when we remember the mechanical analogy, that the greater the self-induction and the larger the capacity, the slower the rate at which the arrangement will swing, a large capacity corresponding to a weak spring, that is, one that would require a greater length of rope to be moved in order to reach a certain tension.

We have seen that the magnetic lines of force produced by the motion of the electrons do not travel away into space at infinite speed, and that some of the energy of the circuit is radiated away. The amount of this radiation will depend upon whether these magnetic lines are crowded close to the circuit, or whether they are widespread. In Fig 4, we have a long straight wire set vertically, and connected to the earth through a self-induction. Between the wire and the earth is a space filled with air, and having a certain electrical capacity. If the electricity in the wire and surrounding earth is set in motion, an

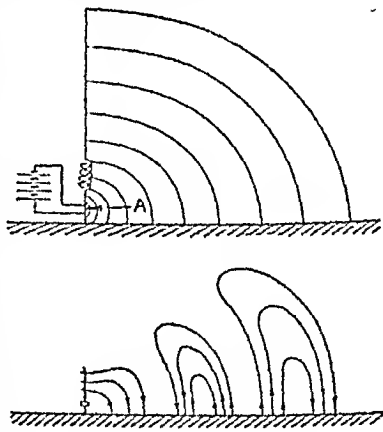


FIG 4

electrical oscillation can be set up, the frequency of which can be calculated or determined. The actual electrical process will consist in the wire having

at one instant an excess of negative electrons and at the next instant a deficiency and an alternating current will flow. It should be noted that while a continuous steady current of electricity can exist only in a closed circuit an alternating current may easily exist in an open circuit. Thus a wireless condenser of considerable capacity, although there is no electrical circuit through it, will take a perceptible current from an alternating electric light supply, this current being the electricity pouring in and out of the condenser as the voltage applied to it alternates.

The top end of the wire will thus oscillate between a positive potential and an equal and opposite negative potential. If we were to cut the wire again at A and apply at this point a considerable potential difference we should obtain a set of lines of force between the wire and the earth which might be of the shape shown but in the actual state of affairs the lines of force are changed round in direction at every half swing of the electricity and these changes do not follow instantly right out into space but take time to complete. Corresponding to these changes we have the production of magnetic lines of force (*see ELECTRO-MAGNETIC INDUCTION*) for a magnetic line of force is merely an expression for the rate of change of an electric line of force in a direction at right angles to the magnetic force. This whole state of alternating electric and magnetic field travels out into space with the velocity of light, the wave length of such an arrangement can easily be determined if its frequency is known. This arrangement is the simple type of wireless aerial first used by Marconi. In order to set the electricity in it oscillating we may make use of the mutual induction of two circuits, by placing near to the inductance through which the aerial is connected to earth a second inductance. If we start a current in the second inductance some of the magnetic lines produced by it thread through the coils of the first

inductance and an EMF is induced in the latter as long as the current in the first is changing.

It is worth while noting at this point the difference between alternating and direct current. If we apply a steady direct voltage to a circuit we eventually and as a rule in an extremely short time obtain a steady current which can be calculated exactly if we know the ohmic resistance of the circuit, and any back EMFs which may exist in it from causes such as chemical polarisation, thermo-electricity, etc. But if we apply an alternating voltage to a circuit we find that the strength of the current produced is now dependent upon three things: the ohmic resistance, the inductance and the radiating power of the circuit. The last like the inductance depends upon the frequency and is greater other things being equal the more the magnetic field of the circuit is spread out. It is now quite a common practice to refer to both the self inductance and the radiating power of a circuit in terms of ohms, the inductance plus the true ohmic resistance being then called impedance. These figures simply mean that the circuit carries the same current with a given EMF as it would do if the effect of the self inductance were obtained by a non-inductive resistance of so many ohms and the same for the radiation resistance. Whereas however the impedance does not help us to calculate the amount of energy absorbed in the circuit, the radiation resistance multiplied by the square of the current gives us the energy actually radiated away, just as the square of the true or ohmic resistance gives us the energy transformed into heat. It should be noted however that both impedance and radiation resistance depend upon the frequency, the former varying directly as the frequency while the latter usually varies as some power of it greater than one. Further discussion of this type of radiation will be found in the article *WIRELESS*.

Everyone is now familiar with the radi

ation sent out by broadcasting stations. These waves are radiated from aërials, or antennæ, as they are also called, the height of which runs to hundreds of feet. Apart from the fact that light travels at the same speed as that of electric waves, its very short wave-length, combined with the fact that we know the atom to contain electric charges in violent motion, is sufficient to suggest that light waves must be very short electric waves broadcast by stations of atomic dimensions. A discussion of the radiation of light, and the shorter waves known as X-rays and γ (gamma) rays, will be found under the heading QUANTUM THEORY, but it is interesting to note here that the feat of bridging the gap between light waves and electric waves has been accomplished. The red rays of the spectrum have the longest wave-length of light rays, this being $c. 700$ millionths of a millimetre. Below these red rays we have the invisible heat rays. These have been traced down to a wave-length of $c. \frac{1}{10}$ millimetre, while the ordinary methods of producing electric waves have been refined until waves as short as $\frac{1}{10}$ millimetre could be produced. It has, moreover, been possible to produce optical interference (see OPTICS, between electric waves and "infra-red," or heat rays).

A word should be said about the reflection of electric waves. When an electric wave meets a conductor, that is to say, a substance in which the electrons are free to move, these will be set into motion by the electric force. If the conductor is a good one, the waves will not penetrate it, their whole energy being absorbed in setting the electrons in motion. This moving electricity, however, will immediately radiate away the energy as it receives it, and it does so in the opposite direction. We can also see that waves in which the electric lines are, say, vertical, will be reflected only by conductors in which the electric lines are also vertical, so that a series of vertical bars will

reflect the waves, while one consisting of horizontal bars will allow them to pass. Such radiation is said to be polarised. If we have radiation vibrating in all directions, only that part parallel to the bars will be reflected, and that at right angles to them be transmitted, radiation vibrating at any other angle being split up into a reflected part and a transmitted part. Such an arrangement, therefore, forms a polariser, familiar in connection with light (see OPTICS) long before it was known in connection with electric radiation. A grating capable of being rotated in its own plane will act as an analyser, and enable us to tell in what direction a wave is polarised, by turning it until it stops all transmission. It is useless to attempt to reflect waves by means of reflectors small compared with the wave-length they are to reflect, this being the reason why it is impossible to build mirrors to catch and send in a certain direction the radiation from an ordinary broadcasting station as the mirror of a searchlight reflects the light from an electric arc. To do this we require to use short waves, and this is now being done in the so-called Beam Stations.

It was for a long time supposed that electric waves produced by ordinary means would fall off so rapidly in intensity with increasing distance from the source that experimenting with them would be impossible, since the amount of energy available would be too small to be detected. The false assumption was made that the intensity would diminish as the square of the distance from the source. This is not the case with the radiating antennæ of the Marconi type shown in Fig. 4, for the electric lines travel away from the radiator in the manner shown in the Fig., each set of loops representing a wave. If the earth were flat, the intensity would fall off roughly in proportion to the distance from the station, as it is, it falls off much more quickly than this. The earth, however, is surrounded by a complete shell of conducting gas called

the Heaviside layer and this acts as a reflector which to some extent neutralises the effect of the earth's curvature (see ATMOSPHERE WIRELESS)

Electrometer see ELECTRICAL MEASURING INSTRUMENTS

Electron the ultimate particle of which all matter is composed. It carries a unit charge of negative electricity and its mass is $\frac{1}{1836}$ that of an atom of hydrogen. See also ATOM

Electro-plating and Electro-typing the coating by an electrical process of an article with another metal or mixture of metals. In electro-plating the article to be coated becomes the cathode in a solution of a salt of the metal with which it is to be plated the anode usually consisting of a piece of the same metal the transfer of metal taking place by electrolysis (see ELECTRO-CHEMISTRY). In electro typing metal is deposited upon a non metallic surface rendered conducting by the application of graphite silver deposited from reducing solutions or other conducting substance. It is used for moulding exactly the form of the surface on which the deposition takes place. In both cases a factor of great importance is the current density usually stated in amperes per sq ft or sq cm. When a current is passed between two metal electrodes in a bath it distributes itself according to the resistance of the path open to it. Thus very little current will reach the side of the cathode which is turned away from the anode and if there are deep hollows in the cathode the current density within these will be much lower than on the raised portions. This effect is compensated in some extent by concentration polarisation. Small objects are kept in constant motion during plating and the deposit thereby made more uniform. The temperature of the bath is also important and successful working depends upon observance of the correct current density and tempera-

ture combined with the use of a bath of correct composition and free from impurities. Careful cleansing of the objects to be plated is essential. Grease the worst kind of dirt in electro plating is removed by heating the object or by boiling in caustic soda. This is followed by pickling in strong acids nitric acid or nitric and sulphuric acid mixed being used for brass copper and other non ferrous metals while iron is usually sand blasted to remove scale and then treated with sulphuric acid.

For copper plating solutions of copper sulphate acidified with sulphuric acid may be used but these are not satisfactory with iron steel or zinc when a bath consisting of copper cyanide dissolved in a solution of potassium cyanide is necessary. It is possible to deposit brass from a cyanide bath containing by weight 4 per cent of potassium cyanide 1.6 per cent copper acetate 0.8 per cent of zinc chloride 8 per cent of sodium sulphide and 11 per cent of ammonium carbonate but it is necessary to adjust the current density very carefully by trial. Silver and gold are always deposited from cyanide baths containing 1.5 per cent of nitrate of silver and 2.5 per cent of cyanide of potassium in the former case while for gold 1 per cent of gold chloride and .5 per cent of potassium cyanide are sufficient. Nickel is usually laid down from a solution of nickel ammonium sulphate (.5 per cent) containing .5 per cent of boric acid. Chromium plating is a difficult operation the metal is not deposited as such by the direct action of the current but is produced by reduction by the hydrogen generated. Chromium plating is frequently used to give a very hard wear resisting surface which also resists tarnishing better than nickel. It is a better reflector of light and heat than the latter metal and hence is coming into use in the manufacture of reflectors.

Recently the electro-plating of

iron has so developed that it will rebuild the surface of worn machinery. Success depends on an elaborate process of surface cleaning, in which electrolysis is used. The bath is a neutral solution of ferrous ammonium sulphate. The deposition of iron upon copper plates for engraving has long been in use, the life of an engraved plate is thereby greatly prolonged, and the coating of iron, which is extremely thin and in no way detracts from the quality of the work, can be renewed if necessary.

Electrosmose is a general term

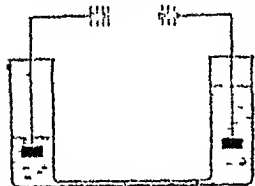


FIG. 1—Movement of Water under Electrosmose

applied to closely allied phenomena of two kinds, *cataphoresis* and *electrosmosis*. In general, any solid body in contact with a liquid acquires what is termed an electrical double layer, the surface of the solid having a positive electric charge and the liquid in contact with it an equal negative charge or *vice versa*. If an electric voltage is applied to the liquid, it tends to cause a slip between these two charges. If, for instance, we have two glass tubes connected by a capillary tube containing water and a pair of platinum electrodes, the glass will charge itself negatively with regard to the water. When we apply a potential difference, there is a small flow of current in the ordinary way, but we also find that the water itself moves towards the negative pole, and actually builds up a difference of level to a point at which this difference forces back water as fast as the applied voltage causes it to move. If instead of performing the experiment in this manner we powder glass very finely and suspend it in water, we shall find that the particles will move towards the positive pole. These effects have nothing whatever to do with the passage through the

liquid of an electric current, which is carried by whatever ions may be present (see ELECTROCHEMISTRY). The effect is found in other liquids also, and solids; a substance of higher dielectric constant (see ELECTRICITY) charges itself positively towards a substance of lower dielectric constant, when we are dealing with good insulators.

Electrosmose finds limited technical applications, though not to the extent hoped for by enthusiasts. If a block of wet peat be pressed between two perforated metal plates, most of the water rapidly flows away when a potential difference of 50 or 100 volts is applied. If electrodes be applied to the ends of a freshly cut log of wood, sap flows away under the influence of a voltage, and will be followed by water if a supply of this is available at the electrode, the washing out of a great many industrial organic substances, such as hides, vegetable products, and so on is accelerated in this way, and it is also possible to introduce substances, such as tans, which are required to act upon the material. If a very fine insoluble

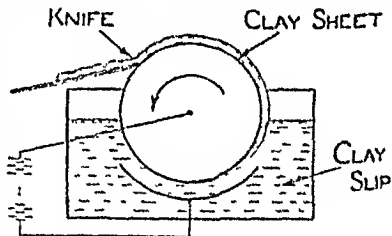


FIG. 2—Refining Clay by Electrosmose

material such as clay, steatite, or alumina is suspended in water containing traces of suitable electrolyte which affect the electric charge of the particles, one of a pair of electrodes immersed in liquid and connected to a source of voltage will become covered with a solid layer of the powder. Objects can be moulded in this way, and it has been used for forming small vessels which are afterwards

red from exceedingly fine powders of refractory substances. On a larger scale it has been made use of for refining clay, or rather for throwing down the clay in a solid mass from a thin slip. The electrode used is a roller and the precipitated clay is stripped off continuously in the form of a thick sheet.

Electrum a naturally occurring alloy of gold and silver. The content of gold is variable, being 60-80 per cent. Other metals such as copper, bismuth or palladium are also sometimes present. **Electrum** was the name applied in ancient Greece to a gold-silver alloy containing 80 per cent gold.

Elegiacs see **VERSE**

Elegit in law writ ordering the seizure of a debtor's land in order to satisfy a judgment debt.

Elegy the name given to a form of poetry of a mournful and reflective character and denoting in particular a song of mourning for some departed friend. The term and the form are alike a legacy from ancient Greek literature. A well known English example is Milton's *Lycidas*.

Elementary Education in England was first organised on a voluntary system in the early years of the 19th cent. the British and Foreign School Society being established in 1808 and the National Society for Promoting the Education of the Poor in the Principles of the Established Church in 1811. These schools aimed at an education which had a leaning towards industrial training as opposed to the preparation for the Universities provided by schools which demanded a considerable fee for the education given in them. In 1833 the first Government grant was made towards free education for the working class £ 0000 being allowed to the two above mentioned societies for school building. Right up to 1880 grants continued to be made and the struggle went on as to whether the schools should be non-denominational or Church of England. The Act of that year established School

Boards and made an attempt so to organise religious instruction that it should be acceptable to all Christians. The School Boards were given powers to make rules regarding compulsory attendance. These Boards were abolished in 1902 by the Education Act of that year. The Board of Education established in 1899 was given very wide powers and Local Educational Authorities were constituted for counties and county boroughs.

The leaving age is a subject of much controversy at present. In London it is 14 but local authorities have power to raise this to 15 and there is a large body of opinion in favour of raising it to 16 largely in order to remove the competition of young people in the labour market.

Pupils in elementary schools may compete for scholarships to secondary schools (qv) and also to central schools (qv) to which there is also a system of entry by recommendation on the basis of the general school record.

In 1930-1 the total number of elementary schools in England and Wales was 9869 with accommodation for 7167667 pupils and an average attendance of 494008. The number of teachers employed was 168934 of which 43538 were men and 153396 women. Local authorities expended in 1930-1 a total of £64919634 on elementary education. See also **EDUCATION**.

Elements The following table gives a complete list of all the chemical elements 92 in number together with their principal physical constants when known. The nature of an element is discussed in the article **CHEMISTRY** and further particulars as to the uses and properties of the individual elements will be found under their own headings. The various elements that have radioactive properties are also discussed in the article **RADIOACTIVITY**.

The atomic weights in the table on pp 64-5 are those given by the International Commission for 1933.

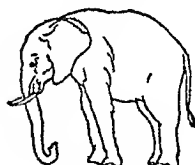
The elements Alabamine Illiumum

incisor teeth, are used for uprooting trees or ripping off strips of bark for food, and also for fighting. For masticating woody and other coarse vegetable fibre the grinding teeth are very elaborate in structure and have broad flat crowns. Owing to the smallness of the mouth, there is only room for one complete tooth above and below on each side at a time. These teeth follow each other along the jaw, the one that is in use, as it becomes gradually smaller with wear, being replaced by another close behind it.

Elephants go about in herds up to c 40, and frequent forest or bush



Indian elephant



African elephant

greatly exaggerated, and is probably not more than 70 years.

There are two existing species of elephant, the Asiatic and the African. The latter has larger ears, a less prominent forehead, and a simpler type of grinding tooth. It is also somewhat larger, big bulls being between 11 and 12 ft high, and weighing over 6 tons. This elephant is now being tamed and worked in certain parts of Africa, but the Asiatic species has been domesticated since the dawn of history, and, on account of its docility, strength, and intelligence, is a most useful beast of burden. It is also used for tiger-shooting, and was formerly employed in warfare. It is possible that the elephants of the Greek armies that

fought against the Romans came from the East, but there is evidence that those Hannibal took across the Alps were the African species, which were potentially as docile as the Asiatic. White elephants occur now and again in Burma and Siam, and are highly prized and regarded as sacred.

Tusks of elephants are the chief source of ivory, and are obtained from both species, those of the African elephant being most prized, on account of their superior size. A single tusk may exceed 11 ft in length and weigh over 200 lb.

Elephanta Isle (*Gharapuri*), island of Bombay Harbour, 5 m from the mainland. There are a number of rock temples and an immense statue of Siva with three faces. The name derived from a huge statue of an elephant which was formerly on the island, it was removed to Bombay in 1864.

Elephantiasis, a disease characterized by inflammation of the fibrous connective tissue, leading to excessive swelling of the leg, scrotum, arm, or breast, and more rarely of other parts, and taking its name from the resemblance to the legs of an elephant brought about in the legs of the patient. It is caused by a parasitic worm, *Filaria*, which blocks the lymph vessels, and at the same time causes irritation of the skin. The disease is practically confined to the tropics, and is influenced by the distribution of mosquitoes. The affected limb should be massaged and elevated, and good results are obtained by injecting fibrolysin daily for several months. Elephantiasis of the scrotum generally produces an enormous tumour, which must be removed by operation.

Elephant Seal, or *Sea Elephant*, is called from being the largest of the seals (*q v*), and from the presence of the nose of the male of a sac of skin which can be inflated to simulate a short trunk. The female is only 10 ft long, but the male is twice the length and has a girth of 15 ft or more. Elephant seals were formerly abundant

on the islands of the S oceans but are now scarce owing to their wholesale slaughter for oil of which a large male will yield over 700 gallons. A smaller kind occurs on the W coast of America as far N as California.

Eleusinian Mysteries [ELUSINIAN] Greek initiation ceremonies connected with the worship of Demeter believed to have been first performed at Eleusis.

Elevators, see CONVEYORS

Elgar Sir Edward (b 1857) greatest English composer since Purcell was born at Broadheath near Worcester. His father was the organist in St George's Roman Catholic Church in that city and his music lessons were practically all that his son ever received. In spite of or because of his complete lack of any academic training Elgar towers above any of his conventionally trained fellow musicians. In his youth he mastered various instruments became highly proficient as a violinist played in orchestras conducted choirs and brass bands accompanied singers and finally succeeded to his father's position as church organist in 1885—all of which helped him to become the master of his instrumentation that he is to-day. In 1889 he married and went to live in London which he left 2 years later disheartened by the lack of interest the music publishers displayed in his works. While he was living in the more congenial environment of Malvern he had his first real success with the cantata *King Olaf* in 1896. Other choral works followed notably the beautiful cycle of *Sea Pictures* written for Clara Butt in 1899 in which the distinctive

Elgar idiom and his easy mastery of the orchestra were already strikingly evident. The same year saw the first performance in London under Richter of his first major work the remarkable *Enigma Variations* and in 1900 his great oratorio *The Dream of Gerontius* was performed at the Birmingham Festival.

It was left to the German nation in general however and to Richard Strauss in particular to appreciate the

full worth and importance of this work when it was performed the following year at Düsseldorf. As a result of his German success Elgar's reputation immediately grew in England and great interest was taken in his next oratorio *The Apostles* and its continuation *The Legend* given at Birmingham in 1903 and 1906 respectively. Manchester heard the magnificent *First Symphony* in 1908 under Richter. The *Violin Concerto* followed in 1910 Kreisler playing the solo part at the Queen's Hall. The *Second Symphony* with its wonderfully ingenious thematic treatment and superb orchestration was first given in 1911. Other works of the first importance are the

symphonic poem *Faust* (1911) ode *The Music Makers* (1911) *Violin Sonata in F Minor* (1919) *Piano Quintet* (1910) and *Violoncello Concerto* (1919). His most important work during his



Sir Edward Elgar

comparatively unproductive recent years is the light but exquisite and characteristic *Nursery Suite* for orchestra. The finest conductor of all these works is the composer himself.

Elgar is now recognised in his own country as the master that he is. He has received the Order of Merit and is Master of the King's Music.

Elgin and Kincardine, Earls of. The earldom of Elgin created 1633 was united with the earldom of Kincardine (created 1647) in 1747. Thomas Bruce 7th Earl (1766-1841) was envoy at Brussels, Berlin and the Porte and brought from Greece to England the Elgin Marbles now in the British Museum. James Bruce 8th Earl (1811-1893) his son was Governor General of Canada from 1847 to

1854, and from 1862 Viceroy of India, where he died. His son, Victor Alexander, 9th Earl (1849-1917), was First Commissioner of Works, 1886, Viceroy of India, 1894-9, and Colonial Secretary, 1905-8. Edward James, his son, 10th Earl (b 1881), has served on many Scottish public bodies, became chairman of the Carnegie United Kingdom Trust, and Lord High Commissioner of the Church of Scotland, 1925-6.

Elgin Marbles, see BRITISH MUSEUM

Elgon, mountain in Uganda, British E Africa, rising above the snow-line. It is an extinct volcano, and remarkable for the caves on its S face. The rim of the crater in parts reaches some 14,000 ft above the sea.

El Greco, see INEOTOCOPULI DO MEXICO

Elijah, a Hebrew prophet, native of Gilead, who lived in the reigns of King Ahab and King Ahaziah of Israel. He led a hermit's life in secluded parts, emerging at intervals to oppose the worship of Baal. It is alleged that he passed into Heaven in a chariot of fire, and there is a lasting Jewish tradition that he will reappear before the coming of the Messiah, the chair of Elijah being still set ready at the Passover meal. In the New Testament he is mentioned as appearing with Moses on the Mount of Transfiguration. The Greek and Roman Churches celebrate the festival of Elijah on July 20. The Greeks regard him as the patron saint of mountains, the Roman Catholics as founder of the Carmelites.

Eliot, George, the pen-name of Mary Ann Evans (1819-1880), whose early reaction against the conventional life of the country gentlefolk left a mark on all her work. Until 1853 she was engaged in work for the *Westminster Review*. In that year she met George Henry Lewes (1817-1878), with whom she was closely associated until his death. Under her famous pseudonym, she now began to produce novels: *Adam Bede* (1859), *The Mill on the Floss* (1860), and *Silas Marner* (1861) justified her

statement that she was incapable of inventing characters or scenery, for they were based on persons and places she had known in her youth. Of her other novels, *Romola* (1862-3), *Felix Holt* (1866), and *Middlemarch* (1871-2) display wide learning but little feeling. She died within 8 months of her marriage to John Cross in 1850, 2 years after the death of Lewes. She was one of the foremost minds of her time, and was highly esteemed by such men as Herbert Spencer and Dickens. *The Mill on the Floss* and *Middlemarch* are considered her best novels.

Eliot, Sir John (1592-1632), English statesman. In 1626, as leader of the Commons, denounced the administration of Buckingham, Charles I's minister, and conveyed his impeachment to the Lords. Eliot was imprisoned in the Tower (1627). After his release in 1628, he brought The Petition of Right before the King, and challenged Charles's right to levy tonnage and poundage. He was again imprisoned in the Tower (1629), where he died.

Eliot, Thomas Stearns (b 1888), Anglo-American poet, is the Editor of *The Criterion*. His works include *The Waste Land* (1922), *Poems* (1909-25), *Ash Wednesday*, *Selected Essays* (1932), and critiques of Dryden, Shakespeare, and Dante. His work has had a great influence on younger contemporary poets.

Elisha, a Hebrew prophet, son of Shaphat, and companion of the prophet Elijah. When the latter was taken up into Heaven, Elisha received his mantle as a sign that he was intended to be his successor. He lived during the reigns of Jehoram, Jehu, Jehoahaz, and Joash, and from time to time exercised considerable influence on public affairs. He performed many miracles.

Elixir of Life, see ALCHEMY

Elizabeth, St. (1207-1231), Hungarian saint, daughter of Andrew II, King of Hungary, and wife of Louis IV, landgrave of Thuringia, famous for her charity and piety.

Elizabeth (1533-1603) Queen of England and Ireland daughter of Henry VIII and Anne Boleyn b at Greenwich. Like her half sister Mary she was declared illegitimate after Henry's marriage with Jane Seymour but unlike Mary spent a comparatively happy childhood and received an extremely thorough education which made her in later life a fit queen to rule a people which both in literature and music was represented by some of the greatest figures in England's history. Elizabeth was well adapted to be the figure head of that brilliant and glamorous company of writers and musicians who are known as the Elizabethans. Her many sided and complex personality inspired men of action no less fervently than men of intellect so that Drake and his intrepid companions invested Gloriana's name with an added colour and glory. Her life before her accession was not without its dangers and at the time of the Wyatt rebellion Mary had her imprisoned in the Tower. But it was also due to Mary that her reign had such an auspicious beginning. A country sickened by the former Queen's merciless persecution of the Protestants and resentful of her marriage to the Spanish and Catholic Philip welcomed with joy a new queen so thoroughly English who was prepared to establish a religious compromise in the interests of the State. She came to the throne in 1558 and set herself to the achievement of a formula which could be subscribed to by Catholic and Protestant. The result was the Thirty-nine Articles which she promulgated in 1563. The skill with which she handled the thorny religious question was extended to her diplomatic relations with foreign powers and here a remarkable capacity for sinking her own personal interests in those of the State enabled her to conceal her political motives in her dealings with foreign princes by a cloak of amorous coyness. Vexatious, capricious, feminine, coarse, forthright, and masculine she emerges from a fog of contradiction and in

decision a great queen in whose name the power of England was established on the seas who alleviated internal economic hardship by the famous Poor Law and retained the affection of her subjects throughout her reign. Her signature to her cousin Mary's death warrant was only obtained with difficulty and delay in spite of the fact that the existence of the Scottish Queen was an ever present danger. And after the tragic death of her former favourite Essex she is said to have been stricken with grief. She died two years later an old and lonely woman frustrated in her natural feminine instincts but a monarch of glorious fulfilment.

Elizabeth Queen of Rumania (1843-1916) married Prince (later King) Charles of Rumania in 1869. She was well known as an authoress under the name of Carmen Sylva and was an enthusiastic patron of Rumanian poetry and legend. Her works include *Les Pensées d'une Reine* (1894) and *Meister Manolo* (1899).

Elizabeth, Princess (1606-1662) eldest daughter of James I of England. The Gunpowder Plot conspirators planned to set her on the throne 1605. In 1613 she married the Elector Palatine Frederick V who was later King of Bohemia. Her daughter Sophia wife of the Elector of Hanover was the mother of George I of England.

Elizabethan Style, a term covering late Tudor and early Renaissance domestic construction in architecture and furniture. Red brick houses were often built in the shape of the letter H or E (the latter in compliment to Queen Elizabeth) with large windows (as Hardwick Hall Derbyshire said to be more glass than wall), low roof and decorative chimneys. Elaborate carving with frequent heraldic devices is seen in the great hall at one end of which are the oak screen and minstrel's gallery. The oak panelling is often inlaid with ebony and box. The main staircase has handsomely carved newel posts and balustrading. Ornamental plaster ceilings predominate.

Examples of this style are Compton Wynyates, Warwickshire, Barsham Abbey, Norfolk, and Sutton Place, near Guildford. The mansions attributed to John Thorpe (Knole, Audley End, Holland House, etc.) belong to the later Jacobean period.

The furniture is typified by the court cupboard. See also FURNITURE.

Elizavetgrad, see ZINOVIEVSK

Elk, the largest of the existing species of deer (*q v*), are found in the central and N districts of Europe, Asia, and N America. They are distinguished by a swollen flexible snout, wide palmated antlers, extending horizontally sideways, and long legs. They feed mostly on foliage, twigs, mosses, and lichens, and in summer wade into rivers for water-lilies and other plants. In N America they are known as moose, the term "Elk" being applied to the wapiti (*q v*). The so-called Irish elk is a huge extinct stag of the European Pleistocene, found especially in peat bogs in Ireland. It is of doubtful affinity, and not closely related to the modern elk.

Elkhound, see ESKIMO DOG

Elkington, George Richards (1801-1805) Inheriting the family silver-plating business in Birmingham, he experimented with the use of electricity in metal-work, and with his cousin and partner, Henry Elkington, took over in 1840 John Wright's invention of an electro-plating process and developed it commercially, founding the English electro-plating industry.

Ell, see WRIGHTS AND MEASURES

Ella (*d c* 510), founder of the kingdom of Sussex. He led the Saxon invasion of Sussex from 477 to 491, repelling the Britons, and capturing the Roman city, Anderida (later Pevensey).

Ellenborough, Edward Law, Earl of (1790-1871), English politician and Governor-General of India. He took part in English politics as member first of the House of Commons, then (1818) of the House of Lords. He served as Lord Privy Seal and later as Member of the Board of Control in the Wellington Government of 1828, and under

Peel. In 1811 he became Governor-General of India. He fought against the Afghans, annexed Sind and pacified the Sikhs, but was recalled by the East India Company in 1814. Subject to hostile criticism, his administration was defended by the Government, and Ellenborough made Earl President of the Board of Control in 1858. He had to resign owing to his censure of the Governor-General of India.

Ellice Islands, see GILBERT AND ELLICE ISLANDS

Ellichpur, town of British India, formerly the chief city of Berar, now of local importance only. It is a centre of cotton trade. Many memorials of past greatness give the town a certain romantic interest. Pop c 24,000.

Elliot, Rt. Hon. Walter (b 1888), Conservative politician. Educated at Glasgow University, he holds the D Sc, LL D, and medical degrees. While a student he was President of the University Socialist Society, but has been an unswerving Conservative since entering Parliament in 1918. He served with distinction in the World War, was made Under-Secretary of State for Scotland (1926-9), and became Financial Secretary to the Treasury, 1931, and Minister of Agriculture, 1932, in which year he was made a Privy Councillor.

Elliott, Ebenezer (1781-1849) English poet and Chartist agitator, known for his *Corn-Law Rhymes* (1831). His well-known hymn, "When wilt Thou save the people?", is still in use.

Ellis, Henry Havelock (b 1859), English psychologist, essayist, and man-of-letters, studied medicine, but practised little. His psychological works include *Man and Woman* (1894), and the monumental *Studies in the Psychology of Sex* (7 vols). Other works include *Impressions and Comments* (1914, 1921, 1924), *Little Essays of Love and Virtue* (1922, 1931), etc.

Ellis Island, a small island, used as an immigration inspection station, in New York Harbour. A naval magazine is situated there.

Ellora, Caves of, a group of temple caves in Hyderabad India near the ruins of Raaja holy shrine of Deccan Mussulmans and the burial ground of Emperors. There are 17 Brahmin caves 12 Buddhist and 5 Jain some dating from the 4th cent A.D. They contain sculptures of various demons gods and goddesses.

Ellore, town of the Madras Province British India formerly capital of the district of the N. Circars. It occupies an important position at the junction of caols from the mouths of the Kistna and Godavari and is a market centre for agricultural produce. Carpets are manufactured. Pop. c 40 000.

Elm, long lived tree with alternate stalked deciduous leaves generally serrated and harsh. In the British Isles two species are known the common elm (*Ulmus campestris*) found throughout S. England and the wych elm (*Ulmus montana*) of N. England and Scotland. The common elm has a smaller leaf than the wych elm.

Elms are noted for the unexpected manner in which large branches may suddenly break off and crash to the ground. The trees themselves are easily uprooted in storms and should not therefore be planted near houses.

The timber is useful as it does not splinter. It is used for furniture paneling tent pegs swingle trees parts of vehicles and coffins and lately a use has been found for sections of elm trunks as attachments to trawling nets.

Much harm has recently been wrought to elms by a disease which has found its way to the British Isles from the Continent and causes the branches to grow abnormally. No preventive against the spreading of this disease has been found other than the destruction of affected trees.

Elman, Mischa (b 1897) famous violinist of Russian birth. He became a pupil of Auer at St. Petersburg under whose tuition he made such remarkable progress that he was soon appearing with sensational success as a

prodigy. By the time he was 16 Elman was a finished artist famous in Europe and America. To-day he is known throughout the world as a violin virtuoso with a technique of the highest order and a remarkably beautiful tone.

Elmina, town of Gold Coast colony British W. Africa. It is not now commercially important but is of interest as the first permanent European settlement by the Portuguese in 1482. The town was taken by the Dutch in 1637. It was sold to Great Britain in 1872. The conditions of the transfer were among the causes of the Ashanti War of 183-4. Pop. c 4 500.

Elmira, city of New York State U.S.A. an important railway centre with manufactures of agricultural machinery railway materials boots and shoes. The battle of Newtown in 1779 which ended in the defeat of the American loyalists and their Indian allies was fought in the neighbourhood. Pop. (1930) 47 400.

El Obeid (EL OBAID) capital of the Khordofan province of Anglo-Egyptian Sudan. It is an important trading centre for gum arabic and ivory. The terminus of the railway running S. from Khartoum is at El Obeid. In 1883 Hicks Pasha's Egyptian army was totally destroyed by the Mahdists near the town. Pop. c 16 500.

Elodea (or *Canadian Pond Weed*) plant growing submerged in water usually floating a little below the surface. It has long green stems and small pointed leaves. It was introduced into English fresh waters inadvertently from Canada and has become a pest in some parts forming dense mats which block the waterway. It is often used in goldfish bowls and freshwater aquaria.

Elor, St. see **St. Eloi**.

Elphinstone, Mountstuart (1779-1859) English statesman and historian. In the service of the East India Company he helped to spread Britain's influence in India serving as aide-de-camp to Wellesley 1803 being sent as Envoy to Kabul 1808 and as

Resident at Poona, 1810-17. Unfortunately, his wide rule in the Deccan was not extended to the whole of India, he refused the Governor-Generalship on account of ill-health. He wrote a *History of India* (1841).

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Vaughan Williams and Elgar, his singing in the latter's *Dream of Gerontius* being his most notable achievement. After his death a memorial to him was placed in the Queen's Hall, London.

Ely, a cathedral city in the Isle of Ely on the Ouse, Cambridgeshire. An active weekly market chiefly comprises market garden produce. There is a large beet-sugar factory. Henry VIII's Grammar School, known as the King's School, Ely, incorporates the gate-house of the old monastery. The



Ely Cathedral

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Elver, see **LEL**.

Elwes, Gervase Henry (1866-1921), English tenor, born at Billing, Northants, and met his death in an accident at Boston, Mass. Elwes excelled in his interpretation of the works of modern English composers, such as

"Porta." The Cathedral (see under **CATHEDRALS**) stands on an eminence, a proud and imposing beacon in Fenland. It is an amazing mixture of styles, yet has a real grandeur. According to the Venerable Bede, the town derived its name from the large number of eels in the river. Pop. (1931) 8382.

Elysium (or *Elysian fields*), in Greek mythology the dwelling-place of the good in the next life. In Homer it was regarded as the home of heroes transferred thither without dying. Later it was thought to be part of the kingdom of the dead.

Elzevir (*Elsevier* or *Elzevier* are alternative spellings) a distinguished family of 17th-cent Dutch printers. The first Elzevir to gain fame was Louis a native of Louvain who established himself in Leyden in 1680. The business which he founded was carried on in Leyden and Amsterdam by his sons and their children until the death in 1712 of his great grandson Peter who was printer to the University of Leyden. The firm produced many beautiful volumes in Latin and Greek as well as in modern languages including two editions of the Greek New Testament and several series of the classical authors of Rome France and Italy. Their publications are of great rarity and value.

Emanation, a curious philosophico-theological doctrine which regards individuals as outpourings of the divine essence. It denies the personality of both God and man. The essence is perfect but individuals are imperfect in accordance with their distance from the essence. Evil is thus a necessary part of the universe inherent in the concept of an individual as distinct from the divine essence.

Emanation, isotropic elements which are obtained on the radio-active disintegration of certain elements. There are three elements obtained most common being the radium emanation an element known as radon (qv). The three emanations belong to the group of elements known as the inert gases (qv) the other radio-active emanations are those from thorium and actinium known as thoron and actinon respectively. They are all short-lived elements which undergo further decomposition. See also **RADIO-ACTIVITY**.

Emancipation Act (Aug 28 1833) abolishing slavery throughout the British colonies. £20 millions was voted as compensation to slave-owners.

Embalming preparation of dead bodies so that they will not decay. The ancient Egyptians were especially expert and many mummies (from the Arab *mumta*) are still preserved.

The motive was probably a wish to keep the body ready for resuming existence in a future life. In the 18th cent European anatomists practised embalming with alcohol oils resin pitch and other aromatics and later injections of fluids of arsenic were used with success. See also **RELIGION PRIMITIVE**.

Ember Days, the Wednesday Friday and Saturday following Sept 14 Dec 13 the first Sunday in Lent and Whitsunday set apart in the Roman Catholic Church and the Church of England for prayer especially for those about to be ordained.

Embezzlement, in law the theft by a clerk or servant of money or goods received by him on behalf of his employer. It differs from larceny in that the original receiving of the property was lawful. The maximum punishment is penal servitude for 14 years. See also **LARCENY**.

Emblematical or Shaped Poems are poems of which the verses are so constructed and arranged as to form a shape having some reference to their subject. Such poems were written by the ancient Greeks and by the later Latin poets and there are English examples in Herbert's *The Altar* and *Easter Wings*. The practice of such writing in European literature has been deservedly ridiculed but it has an honoured place in for example Japanese literature in which a poem is to a large extent valued purely as a picture.

Emblements, the right of an agricultural tenant whose lease lapses before harvest to enter the land and gather the crops. It extends only to annual artificial crops such as corn and potatoes. It arises from the principle that a tenant whose lease depends upon an uncertainty e.g. where he holds under a tenant for life shall not be prejudiced by a sudden determination of his lease. Under the Landlord and Tenant Act 1851 such a tenant for years at a rack rent is entitled in lieu of emblements to remain in occupation until the end of the current year of his tenancy. Under the

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Agricultural Holding Act, 1923, if his land constitutes a "holding," he may continue to occupy it until the tenancy is determined by a 12-months' notice to quit, expiring at the end of the year of the tenancy. See also LANDLORD AND TENANT

Embolism, see COMA

Embolus, see BLOOD-VESSELS, DISEASES OF

Embossing, the art of producing a design on paper, cardboard, metal, leather, etc., by forcing or stamping out appropriate portions of the underside. Paper embossing is effected by a die and counter-die (or force), it may be either plain or in colour. The process is used also for book-binding, textiles, and certain wallpapers.

Embracery, in law, the misdemeanour of attempting to influence a jurymen to favour one side, otherwise than by evidence and argument given in open court. A jurymen allowing himself to be corrupted is equally guilty of embracery.

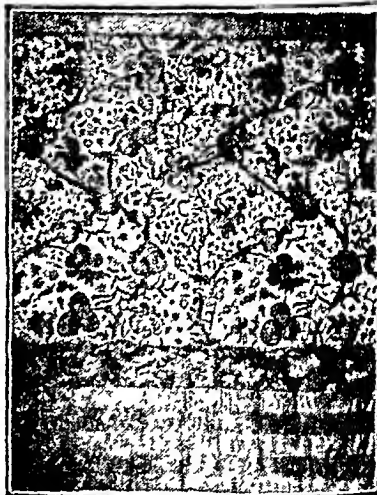
Embrasure [EMBRÄZHÜR], the spaces or openings between two merlons (solid portions) of a battlement.

Embroidery, the art of ornamenting woven fabric into designs in needlework. Embroidery differs from tapestry (*qv*) in that the design is stitched on the top of a woven material, whereas in tapestry the design is woven into it. It differs from needlework in degree rather than in kind, since, while needlework is primarily concerned with use and embroidery primarily with ornament, much needlework is purely ornamental.

The earliest known woven work consists of three linen fragments, found in the tomb of Thothmes IV at Thebes, Egypt (15th cent. B.C.), and now in the Cairo Museum. The technique is that of tapestry, as the pattern (lotus leaves, papyrus blooms, etc.) is worked into the warp and not superimposed on the finished material. Of the needlework of the Ægean, Babylonian, and Assyrian civilisations we have no trace, but we can infer the existence of the art from references in

Homer, from frescoes, and from sculptural reliefs. Frescoes from Tiryns (Peloponnesus) and wall-paintings from Thebes (Egypt) make this quite clear. On the relief from the palace at Susa (now in the British Museum) are figures of soldiers wearing long robes ornamented with some kind of embroidery. Further, we learn from the Bible that the robes of Aaron included a "brodered coat" (Ex. xxviii. 4).

Embroidery was well known to the ancient Greeks. Every 4 years a new embroidered tunic, or *peplos*, was made



Crewel Work, c. 1650

for the statue of Athena in the Parthenon at Athens, the presentation of the garment was attended with solemn ritual, as it was carried in the Panathenaic procession. Some Greek embroideries ascribed to the 4-3rd cents. B.C., which were found in 1872 in a grave at Kerch in the Crimea, attest to Greek familiarity with the art. The Romans worked in embroidery, attributing its invention to the Phrygians. Attalus II of Pergamum is said to have invented the art of embroidering in gold, though we read in the Psalms (xlv. 13, 14) of the

king's daughter having clothing of wrought gold and being brought unto the king in raiment of needlework. The mummy wrappings from the tombs of Upper Egypt (to the 5th cent. A.D.) include fragments of embroidery showing Roman influence. Byzantine embroidery is characterized by rigidity and lack of inspiration and from the 6th to the 11th cent. Byzantine art influenced the whole of Europe. A noted example is the so-called dalmatic of Charlemagne (preserved at St. Peter's Rome) now generally

cent the best embroidery in Europe was being made in England a well known example being the Syncope (now at St. Kensington). Though the quality fell off in the 14-16th cent. the Tudor period was characterised by magnificence in dress the portraits of Henry VIII and Elizabeth are familiar. About this time *petit point* needlework became known this is a form of embroidery in which we have all worked into material with an open mesh such as canvas the material being completely covered by the needle



17th-Cent Brussels Needlework Panel.

attributed to the 11th cent. After the capture of Constantinople in 1204 by the Latin crusaders the Norman kings of Sicily placed the Byzantine emperors as patrons of the arts and Palermo became the artistic centre of Europe. Henceforth the art developed along national lines. The most elaborate garments were the vestments of the priests though the dress of private individuals was often richly ornamented. A needlework is possibly English. By the 13th

work. A coarser method is known as *gross point*. The French names of these styles suggests that they were introduced from France where they were very popular. After the Reformation embroidered church vestments temporarily went out of favour and during the Commonwealth the dress of private individuals was devoid of ornament but after the Restoration and during most of the 18th cent. women's dresses and men's coats and waistcoats were richly embroidered. Indeed to the end of the 19th cent. a

waistcoat was considered to be an elegant article of men's attire During

of woven material, and the edges are embroidered

While the art developed in Europe along national lines, except in Spain where Eastern influence was naturally strong during the Moorish occupation,



Scalloping

it flourished also in India and the Far East Chinese embroidery is perhaps the most intricate of all. Not only is the needlework itself beyond reproach, but the fabric on which it is worked is previously ornamented In Indian work, on the other hand, the most exquisite needlework is often seen on very poor fabric, with the result that the material wears out before the design Frequently gold thread and occasionally small pieces of looking-glass are introduced into the pattern.

All the work referred to above is of course hand-embroidery During the 19th cent machine-made work became very common all over the world, but, while it doubtless has its place in civilisation, it will probably never quite replace the finer hand-stitchery, which

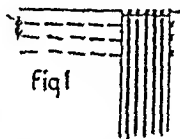


fig 1



fig 2

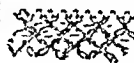


fig 3

Smocking

has always been regarded as an eminently suitable occupation for women of leisure.

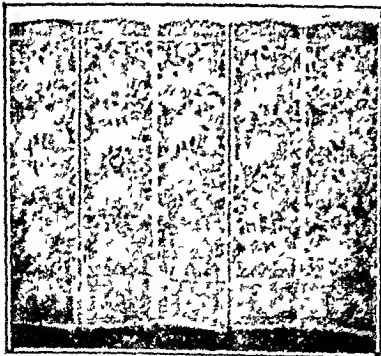
For the different kinds of stitches used in embroidery, see NEEDLEWORK See also LACE

Motif a small design either inset or embroidered on a plain ground. They



Sampler 19th Cent

the same period embroidery was applied also to curtains, coverlets and hangings The art was expressed equally skilfully in smaller objects such as samplers, silk pictures (both portraits and landscapes), maps, and work-box covers. *appliqué* work, too,



Queen Anne Screen

has a long history In this work cloth or silk patterns are sewn on to a piece

may be worked as embroidered monograms or initials

Scalloping An edging made with button hole stitch (*qt*)

Smocking the decoration of gathers with fancy stitches—a very old craft. Each county has its own patterns. Smocks worn by country labourers in the 19th cent. were worked in a great variety of patterns. Almost any fancy stitch can be worked on smocking gathers—but stem cable and chain stitch and variations of feather stitch are commonest. Fig 1 shows the method of gathering the material and Figs 2 and 3 stem stitch and honey combing the basic stitches from which more elaborate work can be built up.

Spiderweb filloys to draw thread work at the corners where a square is left open through both warp and weft threads being drawn out.



Spiderweb

Stiletto a small cylindrical instrument tapering to a sharp point used in embroidery for piercing holes which are either button holed or stitched round. This instrument is used a great deal on Broderie Anglaise.

Transfer an embroidery design ready drawn on tissue paper so a special ink which can be ironed on to any material. Any designs can be made up on tissue paper with transfer ink.

Embryology the study of the development of embryos of animals and plants from egg cells or ova. Since the ova of most organisms do not develop before fertilisation the study of embryology begins with fertilisation and follows the subsequent changes of the fertilised ovum and the conditions influencing its development. A animal ovum is a cell (*qv*) consisting of a

nucleus in a mass of cytoplasm with food granules. At first the ovum may resemble an *Amoeba* (*qv*) in being able to change its shape but ultimately it becomes spherical. The fertilising cell or male gamete is the spermatozoon which is typically a minute cell with a comparatively large nucleus surrounded by a thin layer of cytoplasm ending in a fine tail like thread the flagellum. This helps to propel the cell moving like a corkscrew to the ovum which it enters. Some of the Crustacea and the thread worms produce tailless spermatozoa which move in the same way as an *Amoeba*. Immediately after the entrance of the spermatozoon the ovum forms a firm membrane excluding other spermatozoa. The nucleus of the spermatozoon approaches that of the ovum and eventually fuses with it but in some cases the two nuclei will both divide and the daughter nuclei of each fuse. In every subsequent division of the fused nuclei half the chromosomes are from each parent. This is of great importance in heredity (*qt*) and one of the major achievements of fertilisation is the bringing together of the two sets of material which produce a new organism having the characteristics of both parents. Amongst invertebrate animals embryos are sometimes produced by unfertilised eggs. This phenomenon is parthenogenesis (virgin birth). Eggs of some sea anemones certain worms sea urchins aphids gall flies and even of bees will develop without fertilisation. Aphids and gall flies produce several generations of flies parthenogenetically followed by a generation from fertilised eggs. Drones develop from parthenogenetic ova queen bees and workers from fertilised ones. Evidently fertilisation is not always essential for development of the ovum of the invertebrate animals but the ovum of vertebrate animals does not develop unless it is fertilised. The spermatozoon provides a stimulus to rapid division along a definite plan which is affected by the presence or absence of yolk.

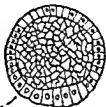
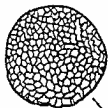
Eggs of many invertebrate animals such as corals, certain sponges, Echinodermata, and of one vertebrate animal, the lancelet, have their food store distributed practically uniformly throughout the ovum. These eggs divide repeatedly into approximately equal cells, ultimately forming a hollow sphere, the blastula (*q v*), with a central cavity, the blastocoel. Subsequent development causes the formation of a cup-shaped gastrula with a hollow space enclosed between the inside and outside walls of the cup, such as could be produced by indenting one side of the blastula. This indentation or invagination actually does occur as a result of the pressure due to rapid division of the cells of one portion of the blastula. The inside wall now becomes the endoderm and the outer ectoderm. So far the same course of development is followed by cells with yolk. In amphibia and some fishes the yolk is at one side, the vegetative pole, and the ovum at the other side, or animal pole, of the egg. The yolk consists of heavy particles less readily divided than the ovum, consequently the blastula consists of many small cells at the animal pole and a few large cells at the other. Reptiles, Birds, most Fishes, and the lowest Mammals have such a large mass of yolk that it is never completely divided, and the division of the ovum results in a layer of cells, the germinal disc, at the animal pole. From the endoderm of the gastrula cells wander into the enclosed cavity, or are separated by division, or hollow sacs are formed by the infolding of the endoderm sacs. All the cells so formed between ectoderm and endoderm constitute the mesoderm, and from these three layers all the organs of the animal are formed. Development of different animals differs in detail, and it is possible here to consider only three main types: a yolkless egg, an egg with considerable yolk, and the ovum of the higher Mammals.

In the embryonic states of the lancelet the gastrula grows longer and

its opening, the blastopore, becomes narrowed. Owing to growth taking place chiefly on one side, the blastopore is pushed toward the future upper dorsal surface at the hinder end of the animal. The cells of this surface become long, narrow columnar cells like bricks on end, and constitute a neural plate. On either side the ectoderm grows outwards and upwards to form a roof, also enclosing the blastopore. The sides of the roof meet in the middle forming a hollow tube, the neural canal, which, through the blastopore, is in communication with the hollow of the gastrula. The hollow is the gut. Eventually the wall of the neural tube forms the nerve cord and is separated from the gut by the closure of the blastopore region. Beneath the neural canal the endoderm folds in to form a long tube, which becomes the notochord. In higher vertebrates the notochord is replaced by bone, forming the vertebral column or spine. The mesoderm is formed by more infolding of the endoderm into three anterior pouches and a pair of grooves extending behind these to the end of the animal. From the grooves, paired pouches or somites are cut off continuously from the anterior towards the posterior end as growth proceeds, until about fifty pairs are formed. At the beginning of this process, about eight hours after fertilization, the egg membrane bursts, and the minute incompletely-developed lancelet emerges as a larva which continues to feed on the remains of the food store originally present in the ovum. The upper parts of the somites and of the two lateral anterior pouches form muscles; the lower parts of the pairs join with each other and with consecutive pairs to form a long continuous body cavity. The gut widens in front, forming a pharynx, which lies against the ectoderm on the left side where an opening, the mouth, is formed. Simultaneously, a gill slit develops from a pouch below the pharynx and opens ventrally through the ectoderm, while on the upper right

EMBRYOLOGY

Amphioxus



BLASTULA



Gastrula



Mesoderm
Formation



Coelomic
Pouches

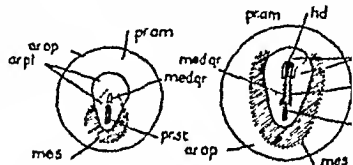


YOUNG LARVA

side a corresponding pouch grows downwards and forwards, opening just below the mouth and anterior to it. This pouch, named the "club-shaped gland," and disappearing later in development, probably corresponds to the first gill slit. The gill slit moves round to the right side of the body and is followed by a number of gill slits developing in the same curious way as outgrowths of the ventral pouches of the pharynx, opening first ventrally and then moving to the right side. Later in development eight of these slits move to the left side after a corresponding number of slits has been formed on the right side. The six first formed are lost. The anus is formed in the region of the blastopore soon after the first gill slit appears, and the larva now procures food by the vigorous movement of fine hairs, the cilia, which line the gill slit and create a water current entering the mouth and passing out through the slit. Minute organisms carried in by the current are caught in a slime or mucus secreted by a bar of cells in the mid-ventral region of the pharynx, and are swallowed. During three months' slow and continuous growth, connective tissue is formed by the somites and ensheathes the notochord and nerve cord. From each division above the pharynx, a gonad, a rudimentary reproductive organ, is developed by downgrowth of the cells, and the larva then begins to sink to the bottom. Its metamorphosis (*q v*), the change to the adult form, is accomplished in about three weeks.

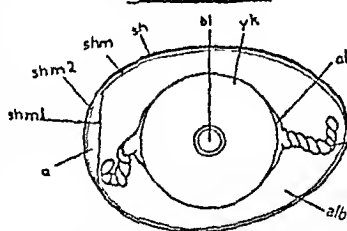
In the embryology of birds the germinal disc around the animal pole consists of well-differentiated columnar cells, but those at the edges of the disc have more yolk, are less regular, and grade off into a region of yolk with a few nuclei scattered in undivided cytoplasm. The blastocœle appears as little more than a slit between the columnar and irregular cells. At the junction of these cells, in the region which will form the hinder end of the chick, an ingrowth takes place, blocking up the cavity and forming a

narrower cavity which may be regarded as the primitive gut, corresponding to that of a gastrula, but with its lateral side consisting of yolk. On the opposite side the junction of the two types of cells forms a crescent-shaped groove. At this stage, the egg is usually fertilized. The "white" forms a proteose medium, and the double membrane lining the shell forms at the broad



Early Development of *Gallus domesticus* (Domestic Fowl)

Ar op	area opaca	hd	head	Med	Medial groove
Ar pl	area pellucida	Med gr			
Mes	Mesoderm (dotted outline and shade)	Pr st	Primitive streak		
Pram	Proamion				
Pr v	Proto-vertebrae				



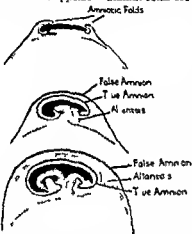
Gallus domesticus (Domestic Fowl)

Semi-diagrammatic view of egg at time of laying.

A air space Alb Dense layer of albumen
Alb1 More fluid albumin Bt, Blastoderm
Ch Chalazae Sh Shell Shm Shell Membrane
Shm 1 and 2, two layers separated by air cavity

an air cavity, which can easily be seen in an egg boiled a few days after laying. During incubation the cells, particularly those lying directly on the yolk, grow rapidly over its surface and form a blastoderm, enclosing it. Through the middle of the clear area above the primitive gut is a band of cells described as the primitive streak, undented, forming the primitive groove. The cells of this region grow inward and by division form a notochord, a

masses of cells at each side forming the mesoderm and corresponding to the two long grooves of the lancelet. A nerve plate several cells thick is formed and folded over in a somewhat similar manner to that of the lancelet. Gill slits appear in the pharynx showing that in the course of evolution (q.v.) birds and fishes probably had a common ancestor but gills are not developed. During the second day of incubation the embryo sinks somewhat into the yolk and at each end a double fold appears. Similar folds are



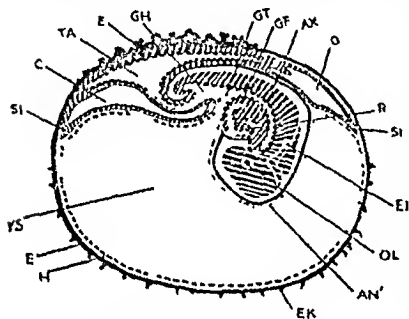
Development of a chick embryo showing Fetal Membranes.

formed at the sides of the embryo and as growth proceeds all the folds coalesce enclosing the embryo in a double sac separating it from the yolk except for a narrow stalk like region. The inner fold is the true amnion and the outer the false amnion. Between the two the hinder end of the gut grows out to form a mushroom shaped sac the allantois with its outer surface closely applied to the false amnion. The allantois has a network of fine blood capillaries which absorb the albumen of the white of the egg and pass it on to the embryo. Oxygen is absorbed from the air that passes

through the porous shell and membranes. The allantois also receives some of the waste products resulting from respiration and consequently acts as an excretory organ. The embryo is curved in the egg and the head so sharply bent that a number of the segments formed by the division of the mesoderm become included in the skull. The gill slits are covered by the growth of skin over all of them excepting the first which form the middle ear on each side. The mesoderm forms the connective tissues, muscles, blood vessels, kidneys and gonads. The endoderm gives rise to the linings of the digestive system, lungs and windpipe and to the liver and pancreas.

During development the very minute egg of all mammals except Monotremes (q.v.) becomes completely divided into a solid sphere of cells consisting of an outer and inner layer. The former gives rise later to the nervous system, skin and other organs and also to a wall the trophoblast (food sprout) which forms finger like outgrowths the villi establishing a close connection with the wall of the uterus or womb in which the embryo develops. The trophoblast absorbs food from the blood of the mother and transports it to the embryo. The inner cells of the layer separate forming a hollow the yolk sac quite devoid of yolk but corresponding in position to the yolk sac of the bird. The lining of the roof of this sac gives rise to the lining of the gut. The embryo is separated from the yolk sac by the development of a double fold growing up round it and roofing it in. The edges of the folds fuse and the inner layer forms the true amnion. The outer one forms a false amnion lying directly within the trophoblast. As in the chick an allantois develops from the gut spreads beneath and fuses with the false amnion. The fused layers together with the associated trophoblast form a feeding mechanism peculiar to the higher mammals and described as the placenta. The wall of the uterus becomes

spongy in the placental region and forms small spaces, which become filled with the blood escaping from the capillaries of the mother. From this blood the villi absorb the food. The severance of the connection of the allantois and yolk sac with the embryo is shown after birth as the navel. The primitive streak and primitive groove are formed early in development, and the layers of ectoderm, endoderm, and



Embryo of a Rabbit

- AN Pro amnion
- C Extra Embryonic Portion of Coelom
- GH Fore Gut
- GH Hind Gut
- GT Mid Gut
- H Endoderm
- O Extra Embryonic Coelom
- OL Lens of Eye
- R Heart
- SI Sinus Terminis
- AX Cavity of Amnion
- E Ectoderm
- FI Thickened Ectoderm by which the vesicle is attached to the uterus and from which the foetal part of the Placenta is derived
- LI Auditory vesicle
- FK Ectodermal villi
- YS Yolk Sac
- TA Allantoic cavity

mesoderm play their part in differentiation in a manner similar to that in the chick. The ectoderm gives rise to the skin, hair, enamel of teeth, sweat glands, the nervous system and lens of the eye, the hind gut, and membranes of mouth and nostrils. From the mesoderm develop the bones and marrow, dentine of teeth, connective tissues, muscles, blood, lymph, blood-vessels, external membranes of heart, lungs, and digestive system, gonads,

kidneys and ureters, and fat. The endoderm produces the linings of the digestive system, larynx, windpipe, lungs, the notochord, and the tissues of the liver, pancreas, thyroid, and thymic glands.

In recent years a number of experiments have been carried out to discover the factors influencing development. This work has become so extensive that it forms a special branch of embryology. The experiments have been concerned mainly in determining (1) the conditions effecting partial genetic development, (2) the particular function of the spermatozoon, the stage at which the cells of the spermated ovum acquire different potentialities, and (4) the effect of abnormal conditions and of injury on development.

Parthenogenetic development has been experimentally induced by physical and by chemical changes. Frog's eggs will divide after they have been pricked with a fine needle. Exposure to a relatively high temperature will activate the eggs of starfish, and unfertilised eggs of sea-urchins will develop after immersion first in a very dilute acid, such as weak vinegar, and subsequent transference to sea-water containing additional salt. These experiments, and the occurrence of parthenogenesis as a natural phenomenon in many insects and plants, show that the ovum contains all the material essential to produce a new individual. The inference is that the spermatozoon probably acts in a manner similar to physical and chemical stimuli, starting a sequence of changes in much the same way as the application of a lighted match to gunpowder begins a series of reactions. Another function of the spermatozoon is to introduce into the ovum new material that will influence the development of the embryo to such an extent that it will develop characteristics of both parents, although this is not always obvious. For instance, the eggs of the American "sand-dollar," fertilised by spermatozoa of another species of sea-urchin,

develop into young of the sand dollar type. Enucleated eggs have been induced to develop by the entrance of a spermatozoon into each but so far no conclusive results have been obtained from these experiments since the animal usually dies in the larval stage.

One of the earliest experiments to find when the cells of the dividing ovum became differentiated was that of killing with a red hot needle one of the two cells formed by division of the frog's egg. Poux found that the remaining cell after forming a half blastula and half gastrula either died or eventually developed into a complete tadpole. This experiment was repeated by Hertwig who ascribed the failure to form a tadpole to the position of the dead cell. It was shown subsequently by Brachet that results depended on the plane in which the first division of the ovum took place. When this plane coincided with that passing through the course taken by the spermatozoon in its movement from the periphery to the nucleus of the egg each cell was capable of developing only into a half tadpole. When the planes did not coincide the development was completed and the difference must have been due to differences in the cytoplasm in different regions of the ovum. In the case of the sea urchin even when 3 cells have resulted from successive divisions of the ovum any of these cells separated from the vegetative pole may grow into a complete animal. Failures in development are much more frequent than in those of cells from the two, four and eight-celled stages. The failures seem to be due rather to lack of material than to inherent differences in the cell.

Generally speaking abnormal conditions result in abnormal development but injury to the cytoplasm soon after fertilisation does not usually affect development. When a two-celled frog's egg is prevented from orientating itself by fixing it between two glass

plates and is inverted in clean water for nearly a week either a double headed or a two tailed tadpole is developed owing to the redistribution of materials in the cells under the influence of gravity. Increasingly greater effects are produced with increase in time after fertilisation. Eggs may be divided into two types according to the arrangement of the materials within them in a definite pattern or the absence of such arrangement. The existence of this pattern or mosaic is shown by centrifuging the eggs and so causing a redistribution of their materials. When the egg of the parasitic worm *Ascaris* is treated in this way it develops abnormally whereas centrifuged eggs of frogs and sea urchins develop in the normal way. Thus differentiation exists in the egg of *Ascaris* even before division but may not occur in the sea urchin until after the 32-celled stage has been reached.

Experiments to determine the beginning of differentiation have been made by grafting cells into different regions of the body. Undifferentiated cells will grow and later become differentiated into the tissues appropriate to the region of transplantation whereas if differentiation be started even if it be only incipient the transplanted cells will develop into the tissue that they would have formed before they were transferred. This may be illustrated by experiments made on dark and light skinned European newts. Before gastrula formation corresponding cells from the two species may be exchanged without interfering with normal development except in the colouring of the areas. After the gastrula stage has been reached a portion of the blastopore concerned with the formation of the nerve cord when transplanted into a different region of the other newt will produce a nerve cord notwithstanding the fact that a normal nerve cord is produced as usual. Constriction of the gastrulas of these newts shows that the part with the dorsal lip of the blasto-

pore grows, and the other part atrophies. Constriction in a plane through the blastopore results in the growth of a two-headed newt. The blastopore is evidently an important differentiating region and has been termed an "organiser" since, transplanted to another region, it induces the surrounding cells to grow into organs normally produced by cells around the blastopore.

One of the important conclusions of experimental embryology is that environment may change the function of growing cells. Their growth and differentiation are influenced by the presence or absence of other cells, by gravity, and various other stimuli. Knowledge of embryology is essential to the gynaecologist and obstetrician. The study is also of great importance in theories of evolution.

The development of plants is simpler than that of animals, and plant embryology is usually included with general botany.

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Emden, seaport town, on a ship canal near the mouth of the Ems, Hanover, Prussia. Apart from the normal shipping that enters the port, trade is done in shipbuilding, cement, chemicals, and the manufacture of rope. The herring industry absorbs the remainder of the male working population. Down to 1744 it was a free town, in appearance Dutch, owing to the number of navigable canals. Pop 31,700.

"Emden," German light cruiser, launched in 1908, achieving world-wide notoriety by its attacks on British and Allied shipping and seaports in the East during the World War. Its commander, von Muller, and crew were eventually captured by the Australian cruiser *Sydney*, off North Keeling Island in the Indian Ocean, where the *Emden* was destroyed on Nov 9, 1914.

Emerald, a precious stone, principally the colourless beryl (beryllium aluminium meta-silicate $\text{Be}_2\text{Al}_2(\text{SiO}_3)_6$), coloured green by small traces of chromium compounds. The Oriental emerald is a green variety of transparent corundum, similar to the sapphire in structure but not in colour. A pale blue-green emerald is known as the aquamarine. Emeralds are mined chiefly in Colombia, S America, and in Ceylon (*see* GEM).

Emeritus, originally a Roman term used to describe military and civil officers, who received honourable discharge after many years' service. In the modern sense, applied to university professors who vacate the chairs they hold owing to age or illness, after long service.

Emerson, Ralph Waldo (1803-1882), American essayist, philosopher, and poet, expressed himself perhaps most clearly in his lectures. He was opposed to rationalism, but offered as alternative a rather vague pantheistic idealism, more theoretical than practical. His *Essays* lack logical development, and are governed by his emotions, but are accepted as eloquent expressions of deep and beautiful thoughts. His poetry is harsh and unmetrical, though, again, its substance is often lofty and original. He enjoys, however, a great reputation especially in America, as an apostle of freedom and humanity, and his work has exerted considerable influence on American thought and prose style.

Emery, an impure naturally occurring fine-grained aluminium oxide or alumina, Al_2O_3 , employed widely as an abrasive. The average sample of emery usually consists of about 60 per cent of pure alumina as corundum, and about 40 per cent of iron oxide in the form of magnetite, with smaller amounts of other minerals. *See also* ABRASIVES.

Emessa, Siege of (A.D. 272) the Palmyrenians under Zenobia were completely defeated by the Romans under Aurelian, who at once laid siege to Palmyra. He took the town early

in * 3 after a stubborn defence by the Queen

Emetic, *see* Poisons

Emetine, an alkaloid obtained from the dried roots of *Psychotria speciosa* a Brazilian plant now also cultivated in the E Indies. Emetine is a white powder with a melting point of 68 C. it is employed in the treatment of amebic dysentery and also as an anthelmintic. It is usually given in the form of the hydrochloride which is water soluble.

Emigration, departure from one's native country in order to take up permanent residence in another. In the form of communal nomadic wandering it was common among pastoral and hunting peoples and also among warlike conquering tribes such as the

apparently inexhaustible areas of new land available and the rapid fortunes accumulated there shifted the magnetic centre for emigrants. At first the flow was chiefly from the United Kingdom and especially from poverty stricken Ireland. Between 1850 and 1890 Germany supplied between a quarter and a third of the emigrants to the U.S.A. while in the nineties large numbers of unskilled labourers from Italy, Austria, Hungary, Russia and E. Europe flowed into railway building and other vast works of the industrial era. The gradual shifting of the centres of emigration from the highly developed countries to the poorer and more primitive is shown in the following table analysing the nationality of immigrants into the U.S.A.

PERCENTAGES

Country	1801-70	1871-80	1891-90	1901-1910	1901-5
Austria-Hungary	0.3	1.4	8.7	16.0	25.0
Germany	34.0	23.8	27.1	14.0	4.4
Great Britain	24.8	24.4	12.3	7.6	8.2
Ireland	15.8	10.5	13.8	10.0	4.8
Italy	0.8	8.0	3.6	18.0	25.0
Norway and Sweden	4.7	7.5	10.8	8.0	8.7
Russia	0.5	2.0	5.8	18.0	17.0

Goths, Huns, Vandals and Tatars. To-day it is limited chiefly to individuals who leave old and densely populated countries in order to find wider opportunities in underdeveloped lands. Emigration to the newly acquired colonies was especially encouraged by the British Government between 1815 and 1850 in order to alleviate unemployment and distress at home and in this period c. 3½ millions left the country several hundred thousand receiving assisted passages and grants of land in Australia, New Zealand and Canada. From c. 1815 until 1910 emigration from the United Kingdom was left almost entirely to individual enterprise and c. 10 millions emigrated between 1853 and the World War.

Meanwhile the gradual westward expansion of the United States the

This form of emigration is almost entirely of strong young people in the prime of life between two thirds and three-quarters being between 15 and 40. Their birth rate is therefore high and immigrant blood assumes an even larger place in the total population than appears from the figure of c. 5 million immigrants who entered the United States between 1860 and the World War.

There is a certain amount of local emigration in Europe especially until recent years from over populated Italy into under populated France.

The greatest emigration movement of the 20th cent. however has been from China into Manchuria thrown open by the overthrow of the Manchurian dynasty in 1911. In post War years the numbers have been as high as one million annually and a total of

c 15 million Chinese labourers are estimated to have settled since 1900

Western emigration has to-day (1933) been brought almost to a standstill by difficult economic conditions in new countries, and in America has been strictly limited, and in practice actually prohibited by the American Quota law. The Empire Settlement Act of 1922, encouraging the co-operation of the British Government in planned land development schemes in different parts of the Empire, though it assisted a quarter of a million emigrants between 1922 and 1926, remains temporarily in abeyance.

Normally, the Overseas Settlement Committee co-operates with certain voluntary emigration societies, such as the Salvation Army, the Church of England Council of Empire Settlement, the Y M C A Migration Department, the Society for the Overseas Settlement of British Women, etc., to assist emigrants on approved schemes.

Émigrés [*pron* EMIGRĀ], the monarchist fugitives from France at the time of the Revolution, 1798. Many settled in Germany, Belgium, Holland, Switzerland, and the United States, while others joined the armies fighting against Napoleon. Their estates were confiscated, though an amnesty was granted in 1800. The name is also applied to the Russian aristocrats and others who fled their country on the Revolution of 1917, a very large number of whom settled in France and especially in Paris, the headquarters of the White Russians abroad.

Eminent Domain, the right of the State to use private property for public purposes, particularly in war-time.

Eminescu, Mihail (1849-1889), Rumanian poet, studied philosophy, began life as a teacher and was then appointed to the University Library at Jassy. He later became Editor of *Timpu*, a Rumanian Conservative paper. He developed symptoms of madness in 1883, and was killed by a fellow-madman in an institution in 1889. His poetry is characterised by

two themes—love and the beauty of Nature. His work is rather melancholy, but often satiric. Two well-known poems are *Venere si Madona* and *Epigoni*, 1870, and the *Emperor and Proletarian* and *Evening Star* are famous. His short story, *The Poor Dionise*, holds a high place in Rumanian literature.

Emin Pasha (*Eduard Schnitzer*) (1840-1892), German administrator, served as medical officer to the Turkish Government, and later under General Gordon in Egypt, acting as sole Governor of the Sudan Equatorial Province, after the death of Gordon and fall of Khartoum, till Stanley relieved him in 1888. He was then sent to Central Africa by the German Government, being killed by Arab slavers in the Congo Free State. Emin Pasha abolished slavery in his territory and carried out scientific surveys.

Emmanuel (*Heb* "God with us"), a name prophetically given by Isaiah to the future redeemer of the Hebrew nation, and applied in the Gospel of St Matthew to Christ.

Emmerich, manufacturing town of Rhenish Prussia close to the frontier of Holland. The town is in the district of Guelderland and was acquired by Prussia in 1715. It is historically interesting in connection with St. Willibrord, the 7th-cent English missionary to the Germans. Pop c 13,500.

Emmet, Robert (1778-1803), Irish rebel. Emmet joined the United Irishmen with his brother, Thomas Emmet, and in 1802 visited Paris to interview Napoleon, then planning an invasion of England. Returning to Dublin, Emmet plotted for an armed rising against the British administration. His colleagues failed to co-operate, and after the murder of Lord Kilwarden by his followers, Emmet was tried for high treason and hanged.

Emotions, see PERCEPTION.

Empedocles (c 476-435 B.C.), Greek philosopher and statesman, who believed that at one time love was pre-

dominant and all the elements formed one great sphere. Discord however set in and separated the elements and the two principles are still struggling. The elements combined through love with quaint results: i.e. heads, arms, legs and bodies came together in wrong combinations forming centaurs and the like, but these forms soon gave way to more reasonable shapes. A crude attempt at survival of the fittest may be read into this idea. Empedocles also expounded the theory of the transmigration of souls. See also PHILOSOPHY ANCIENT.

Emperor title borne by the heads of the Roman State and latterly borrowed by many other monarchs. Originally *imperator* was the title of a commanding general and of a magistrate and the two offices were first combined by Julius Caesar who was *imperator* of home and military affairs. After Augustus the first Roman Emperor the title was borne by all his successors and was taken by Charlemagne when he revived the Holy Roman Empire. From 800 to 1806 it was borne by all monarchs of the Holy Roman Empire and had a special semi-monarchic semi-ecclesiastical significance since the Emperor and the Pope were closely connected. In 1806 the Holy Roman Empire was dissolved and the title became common being taken by Napoleon the Habsburgs the King of Prussia (after 1870) and the sovereigns of England as Emperors of India (since 1876). *Tsar*, *Shah* and *Kaiser* (derived from Lat. *Cæsar*) all have the same meaning as Emperor.

Emperor Moth a handsome moth distinguished by the large eye-shaped patch on each of its wings and the only British representative of the typical saturniid silk moths.

Emphysema, an abnormal presence of air in certain parts of the body. Generally however the term is restricted to a peculiar affection of the lungs exhibited in two forms *vesicular emphysema* dilatation or rupture of the air-sacs and *interlobular emphy-*

sema infiltration of air into the connective tissue beneath the pleura. The former is commoner and may be caused by diseases of the lung or by violent coughing and straining. The symptoms are shortness of breath and a tendency to develop bronchitis. The patient may become puffy and bloated and the chest barrel-shaped. Treatment consists in maintaining the general health and avoiding causes of aggravation. Oxygen may be inhaled during an attack. Interlobular emphysema may accompany the vesicular and has been known to be fatal.

Empire, a large state or federation of states extending over a wide geographical area and usually developed by the absorption of other peoples and countries. Empires are nearly always built up by the virile conquering and colonising expansion of a single State but subsequently the individual provinces gradually attain independence. Of the pre-Grecian empires—Assyrian, Persian, Babylonian—not a great deal is known. Alexander the Great between 333 and 323 B.C. conquered a vast empire in the Near East but it was never consolidated and crumbled at his death. His achievement however was an example to the Romans who from the foundation of a sound republic and with highly efficient armies built up under Julius Caesar and Augustus a closely bound empire which covered the whole known world. In the 4th cent. A.D. the unwieldiness of this vast area caused a split between East and West and two empires formed around Rome and Constantinople. The W. Empire broken up by barbarian invasions was revived in more primitive form by Charlemagne about the year 800 and under the title of the Holy Roman Empire lasted as a fluid and changing area for almost exactly a thousand years until the abdication of Francis II in 1806.

The Arabian Empire which spread right across N. Africa and Spain at the beginning of the 8th cent. was the

sole other imperial power known in the West until the great renaissance of learning and discovery after 1450. Then the sudden burst of maritime explorations, led by Spain and Portugal, sowed the seeds of the huge trans-oceanic empires of the present time. Both these countries established vast empires in the 16th cent, the former in Central America and in the W and S of S America, the latter in Brazil. These empires lasted until the outbreak of democratic independence in the first years of the 19th cent, which split them into republics. Meanwhile Muscovy, under Ivan the Terrible (1462-1505), had expanded S and E into Asia to form the nucleus of the vast continental Russian Empire, enlarged by Peter the Great and subsequent monarchs to include all Siberia, Transcaucasia, and much of Central Asia.

The 19th cent, while it witnessed the break-up of the Iberian Empires, also saw the beginning of the modern race for colonial expansion. Napoleon's European empire was a direct successor to the Roman, and consisted of subject States. But very soon the idea of empire began to include the embracing of distant, unexploited areas which might provide resources of wealth, and ultimately markets, for the mother State. French colonisation in Canada between the 16th and the 18th cents marked the beginning of this phase, which reached its climax in the division of Africa between England, France, Belgium, Germany and Italy between 1830 and 1900. By the end of the cent France had built up a vast coloured empire, including N Africa, the Sahara, Madagascar, and Cochin-China. Germany, hampered by her late achievement of unity, and inheriting some of the tradition of the Holy Roman Empire, conceived a Central European Empire with a possible field of expansion through Turkey into the Near East. She did, however, manage to secure certain unappropriated slices of E. and S W

Africa in addition. The Habsburg monarchy, a direct descendant of the Holy Roman Empire, had meanwhile extended over the mixed minority races of Central Europe to form a large and contiguous, but heterogeneous and very unstable, empire.

In 1914, there were in the West four great autocratic continental empires—Germany, Austria-Hungary, Turkey, and Russia—and two great democratic overseas empires, France and Britain. The World War, with its resurgence of repressed minorities, brought the collapse of the four former and the strengthening of the two latter. The post-War period, with the division of all the available land areas of the world between the great powers, brought a halt in empire-building. An exception was Japan which, ignoring a general agreement to preserve the territorial sovereignty of China, established herself in Manchuria in 1931-2. Germany lost her colonies by the Versailles Treaty.

See also BRITISH EMPIRE

Empire Day, an annual festival inaugurated in 1902 to celebrate on May 24 (Queen Victoria's birthday) the achievement of the British Empire.

Empire Marketing Board, a governmental body formed in 1926 at the instigation of the Imperial Economic Committee to encourage Inter-Imperial trade. It was allocated £1,000,000 a year, which was expended largely in publicity, the perfection of marketing methods, and the subsidising of scientific research by existing organisations. One of its chief activities was the grading of home products, and the application of a "National Mark" to meat, eggs, flour, fruit, and other commodities. Its posters were a feature of all large towns. It was under the chairmanship of the Secretary of State for the Dominions, and was non-political. It was terminated in 1933.

Empire Style, that phase of the neo-classic architectural and furnishing fashion developed by Napoleon through his admiration for Imperial Rome.

Roman precedent was followed in the heavy classical buildings. Egyptian motifs were introduced after the Egyptian campaign 1798. The furniture was modelled on Roman patterns the legs of chairs having outcurving feet. The style is generally unimpaired and heavy. See also ARCHITECTURE and FURNITURE.

Empire Trade. Trade between different parts of the British Empire is growing in importance. The United Kingdom is obtaining an increasing proportion of her supplies of foodstuffs and raw materials from empire countries and is selling an increasing proportion of her total exports to the Dominions, Colonies and Protectorates. The Empire forms a great economic unit which can furnish most of the important needs of its various communities. Essentially the United Kingdom can furnish coal and manufactures while the Dominions and Colonies furnish foods and raw materials. Though not entirely self-sufficient the Empire is capable of producing the greater part of its needs within itself and is tending towards a

degree of self-sufficiency impossible to any other large political unit.

This country depends on imports for more than half her food supplies and for the greater part of all important raw materials except coal (see FOREIGN TRADE) while a large part of the manufactured goods she now imports consists in two classes of semi-raw materials viz petroleum oils and non-ferrous metals chiefly copper and tin.

Before the War about a quarter of the imported foodstuffs came from the Empire in 1931 over 37 per cent (the reckoning of the Irish Free State as a separate Dominion accounts for some of this increase). The proportion of raw materials imported which was purchased from the Empire increased from 5 per cent in 1913 to 28 per cent in 1931. In 1932 the proportion of both foods and raw materials from Empire countries increased materially.

The table which follows shows the figures for retained imports into the United Kingdom by classes of commodities from the Empire and foreign countries in 1913, 1925 and 1929-1931.

RETAINED IMPORTS INTO THE UNITED KINGDOM FROM FOREIGN AND FROM BRITISH COUNTRIES.

Million £

	Year	Foreign	Empire	Total	Empire
Food, drink and tobacco	1913	207.8	71.7	279.5	25.7
	1925	279.9	219.1	499.0	59.4
	1929	272.9	177.2	450.1	34.8
	1931	249.3	147.3	396.6	3.1
Raw materials	1913	134.6	52.6	187.2	4.3
	1925	239.1	90.3	329.4	95.8
	1929	197.4	87.8	285.2	30.7
	1931	105.6	41.4	147.0	23.1
Manufactures	1913	160.2	11.4	171.6	9.6
	1925	35.7	39.8	75.5	10.2
	1929	277.8	9.6	287.4	8.0
	1931	272.2	99.0	371.2	9.0
Total	1913	372.6	133.4	506.0	20.3
	1925	519.0	311.9	830.9	19.0
	1929	570.1	206.6	776.7	36.8
	1931	631.1	246.7	877.8	37.1
Total Import (including goods re-exported)	1931	819.8	247.4	1067.2	94.7
	1932	454.1	249.0	703.1	35.4

The only figure yet available for 1932 is the total imports (including goods re-exported) for all classes of goods from British and from foreign countries.

The products which the Empire could furnish in sufficient amounts to meet the total needs of this country are rubber, wool, and tea, of the total United Kingdom imports of which the Empire supplied, in 1931, 77·7 per cent, 79·7 per cent, and 86·8 per cent respectively. The principal products of which the Empire is not at present able to furnish sufficient supplies are cotton and petroleum.

The Empire production of cotton is, however, rapidly increasing and should become sufficient, while the production of petrol from British coal is now to be undertaken on a larger scale, and it is contended that the entire requirements could be met by the extension of the hydrogenation process. Other import-

ant raw materials and foods which come into the United Kingdom are shown in the table which follows. The more interesting features of the table are the great increase in Empire supplies of tobacco, cotton, and sugar, and the still relatively heavy imports from foreign countries of meat, dairy products, tobacco, cotton, timber, and petroleum.

Though the Empire supplies the United Kingdom with only about a third of all its imports, she is by far the most important market for the goods of all the Dominions (except Canada, which finds an even larger market in the U.S.A.) and for practically all the Colonies and Protectorates. The United Kingdom took in 1931 nearly 90 per cent of New Zealand's total exports, over 30 per cent of Canada's, 44·6 per cent of Australia's, 43 per cent of S. Africa's, 27 per cent of

PROPORTION OF CERTAIN IMPORTANT IMPORTS INTO THE UNITED KINGDOM OBTAINED FROM FOREIGN AND EMPIRE COUNTRIES

Millions of £

	1913			1925			1931		
	Foreign	Empire	Empire % of total	Foreign	Empire	Empire % of total	Foreign	Empire	Empire % of total
Foodstuffs, Drink and Tobacco	217·7	77·5	26·2	311·2	228·9	40·1	250·6	167·2	37·7
Grain and Flour	54·9	29·5	34·9	56·3	51·9	19·3	56·2	19·6	35·1
Meat	12·5	13·9	24·6	79·3	32·1	28·8	72·2	21·7	23·1
Butter, Cheese and Eggs	30·4	10·3	25·3	90·2	31·9	26·1	72·2	21·5	22·8
Fruit (fresh and dried)	12·2	1·6	11·6	27·1	8·9	21·6	26·9	11·0	29·0
Sugar	9	22·1	4·0	25·7	7·5	22·6	8·1	6·4	43·2
Tea	1·7	12·0	87·3	4·1	33·5	89·0	3·9	25·7	86·8
Tobacco	7·9	1	1·2	14·3	1·2	7·7	8·5	1·9	16·3
Raw Materials	178·7	91·2	33·8	265·6	150·2	37·5	111·3	59·7	33·9
Cotton	68·6	1·9	2·7	111·1	12·6	10·2	27·2	3·1	11·7
Timber	28·3	5·5	16·3	10·8	5·6	12·0	26·7	2·5	8·5
Oil-seeds, fats, etc	11·2	15·2	51·7	31·7	23·8	42·9	18·0	6·9	27·7
Wool	9·3	28·1	75·3	12·7	63·1	83·2	7·0	27·5	79·7
Hides, Skins, and Furs	7·0	8·0	53·2	11·6	10·2	16·5	5·5	6·2	53·0
Rubber	9·4	12·1	56·8	7·5	22·9	78·0	1·0	3·5	77·7
Manufactures	178·8	22·2	11·0	282·5	37·1	11·6	235·9	25·8	9·5
Petroleum, refined	10·0	8	7·6	37·5	2·0	5·0	28·9	1·1	3·7
Non ferrous Metals	20·5	12·0	36·9	71·1	11·1	27·0	17·8	6·9	27·9
Total*	577·2	191·5	24·8	891·6	387·9	37·9	613·5	217·4	28·7

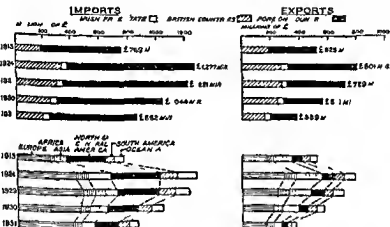
* Including, in addition to the above items, imports by parcel post and living animals (not for food)

India and 96 per cent of Irish Free State total exports in all the United Kingdom buys over 40 per cent of the total exports of all the Empire countries combined. When trade between Empire countries apart from the United Kingdom is added of the total exports of all Empire countries over 50 per cent were to British possessions.

The development of Empire trade has been fostered by the principle of Imperial preference (a lower duty on imports from the Empire than on

ad valorem have been placed on many products if imported from foreign countries while imports from Empire countries are allowed to enter free (see **TARIFF**).

The encouragement of Empire production of other supplies has been fostered in other ways. The development of cotton growing in the Empire has been due largely to the efforts of the Empire Cotton Growing Corporation. Other products have been given encouragement by the high prices



The top diagrams show the relative proportion of Empire and foreign trade with Great Britain below the distribution according to areas.

those from foreign countries). This principle was established in the British tariff during the War Tea sugar tobacco duties etc were levied on Empire goods at 5/6 the ordinary rate.

New tariffs like the McHenry duties on motor-cars musical instruments etc were treated in a similar way while key industry goods (or optical goods chemicals etc) were allowed free entry if produced in the Empire. When the general tariff was imposed in 1931 the principle was carried still farther. Duties ranging from 10 per cent to 30 per cent

prevailing where price control by foreign producers was an important factor—e.g. copper.

The Dominions and Colonies agreed in 1931 at the Ottawa Conference (q.v.) to reciprocate in allowing preferential tariff rates on imports into their territories from the United Kingdom. The Empire as a whole imported £413 millions worth of goods in 1931. Of this £194 millions or 47 per cent was furnished by the United Kingdom £73 millions or 18 per cent by inter Empire trade and the remaining £246 millions or 59 per cent was bought from foreign countries.

tries It is the hope of those who believe in *Empire free trade* that by the application of preference rates on imports from the United Kingdom, the Dominions and Colonies will greatly increase the proportion of their imports from the United Kingdom This undoubtedly occurred to a considerable extent in 1932 Not all of the £276 millions imported by the Empire in 1931 could be replaced by goods from Great Britain, but a considerable portion of that amount could be furnished from this country Canada, for example, could import more of her coal from the United Kingdom and less from the U S A , also more of her iron and steel products and electrical goods , while many Empire countries could purchase a larger proportion of their machinery, motor-cars, textiles and other manufactured goods from us instead of from the U S A , Japan, and other foreign countries Perhaps the United Kingdom exports to the Empire could be increased by somewhere around £100 millions by such taking over of markets in the Empire from foreign competitors The amount is not great when total trade is considered, but with a return of prosperity it would be much greater, and should tend to increase in the future as Empire countries develop and their needs become more complex

Empiricism, in philosophy, the theory that personal experience is the source of all knowledge, and that the mind was originally an absolute blank The theory originated with Heracitus and was characteristic of all early Greek speculative thought The empiric spirit was latent in the Middle Ages, but revived after the time of Francis Bacon and attracted such exponents as Locke, Hume, Mill, Bentham, and Hobbes

Employers' Liability Acts At common law, a master is not responsible for negligent harm done by his servant to a fellow-servant engaged in a common employment with him, unless the harm arose from the

master's own negligence, or resulted from his breach of some absolute statutory duty, such as the duty of putting fencing around dangerous machinery By the Employers' Liability Act (1880) he is responsible for injuries arising from (1) defect in the condition of the ways, works, machinery, or plant connected with the employer's business and the existence of the defect is due to the negligence of the employer, or of a servant entrusted with the charge of these things; (2) negligent superintendence of a servant whose principal duty is that of superintendence (3) negligence of a servant whose order the injured person was bound to obey and did obey when he was injured (4) obedience to the employer's rules (5) negligence of a servant having control of any signal, point, locomotive, or train upon a railway But the servant cannot claim damages if (a) he has contracted out of the Act; or (b) he has been guilty of contributory negligence, or (c) he knew of the defect or negligence and failed within a reasonable time to inform his employer or superior thereof, unless he was aware that his employer or superior knew of the defect or negligence Notice of the injury must be given to the employer within 6 weeks, and the action commenced within 6 months, or, in case of death, 12 months from death, even though, on reasonable grounds, no notice was given The action must be commenced in the County Court The maximum amount recoverable is a sum equal to the estimated earnings of such servant during the 3 years preceding the injury The person injured must be a workman within the meaning of the Act, and thus includes railway servants and any person engaged in manual labour other than domestic menial servants As to the rights of relatives in the case of death, see FACTORY ACCIDENTS ACT See also WORKMEN'S COMPENSATION ACTS

Employment Exchange, or Labour Exchange, a Government office established under the Labour Exchange Act 1909, for the purpose of introducing

unemployed men to vacancies notified by employers and since 1912 of administering unemployment insurance. Employment Exchanges are controlled by the Ministry of Labour and normally fill between 1 and 1½ million vacancies a year. See also UNEMPLOYMENT UNEMPLOYMENT INSURANCE.

Ems, watering place near Coblenz Germany. In the district are valuable thermal springs from which is drawn the famous Ems Water. Pop 7000.

Emu, a large ostrich like bird found in Australia resembling the cassowary in its vestigial wings and double plumed feathers but differing in the absence of the helmet wattles and in the long quills on the wing and in the inner toe bearing a claw of normal size. The hen is larger than the cock bird and utters a guttural growling note. The cock bird incubates the eggs. Emus which feed mainly on vegetable food are now scarce in settled districts where they have been extensively hunted their speed affording good sport when pitted against dogs on the open plains they frequent.

Emulsion, an extremely fine dispersion of a liquid throughout another liquid with which it is immiscible. Emulsions are of great importance industrially (e.g. margarine) and physiologically (e.g. blood). The liquid in greatest proportion is known as the continuous phase the suspended constituent is the disperse phase. Emulsions may be separated into their constituents (broken) by various methods the commonest being an intensification of the gravitational pull by whirling in a centrifuge. Other methods are by heating and cooling or by the addition of various reagents which usually affect the electrical charge on the particles of the disperse phase. Certain substances known as emulsifying agents tend to favour the formation of an emulsion chiefly by lowering the surface tension of the solution and by an electrical effect. See also COLLOIDS.

Enabling Act, popular name of the Church Assembly (Powers) Act

1919 granting a greater measure of self government to the Church of England. This Act constituted the Church Assembly (qv) as the legislative body of the Church of England. Baptised members of the Church of England could be admitted to an Electoral Roll drawn up for each parish. Members on the electoral roll choose a Parochial Church Council. These councils elect representatives to rural dean and diocesan conferences. The powers of these bodies are defined in the Act.

Enamel Vitreous an opaque or



German Enamel c 1450

transparent glaze generally coloured which adheres to a suitable metallic surface when applied in a liquid state. Iron coated with vitreous enamel is now one of the cheapest and commonest materials employed for domestic hollow ware for advertising signs exposed to weather for gas and electric cooking stoves and many other purposes. The enamel must have the

same coefficient of thermal expansion as the metal upon which it is to be fused and while enamels adapted to the precious metals and to copper have long been known, it is only recently that bases suitable for iron have been developed.

Enamels for gold, silver, and copper are generally based upon a composition of silica, lead oxide, and potash, which forms a transparent lead glaze similar to that known as flint. This base readily takes the various metallic



Garrick Presentation Medallion in Enamel, 1777

oxides, which render it opaque or colour it. Opacity is usually produced by oxide of tin and arsenic. The enamel is prepared by fusing the ingredients together, and reducing to a fine powder in an agate mortar. This powder is applied to the metal, which must be perfectly clean, and the work placed in a muffle furnace for a few minutes until the enamel is seen to melt and spread over the surface. The art of enamelling is thus fundamentally very simple, but the attainment of the highest degree of beauty and perfection demands great skill and long practice.

Much decorative enamel consists of fields of opaque colour in various patterns, separated from one another by narrow strips of metal. The most familiar type is *cloisonné*, made by bending thin metal strips to the outline required and fixing them to a metal plate by means of silver solder or the enamel itself. The various parts of the design are then filled with the different colours, which are fused, several coats being given if necessary to get a perfect surface. The whole is then smoothed level by grinding with an abrasive, and polished with rouge. The design may also be cut in the solid metal (*champlevé*). Commercial porcelain enamel dates from about the year 1830 and was introduced into England about 1840.

Articles to be enamelled are now mainly made by stamping and pressing mild steel sheet (*see METALS, PLASTIC WORKING* or), cast iron is chiefly used for baths. The first coat of enamel is grey and serves as a base for the finishing coats. It varies in composition, but no lead is permissible in vessels to be used for cooking. The cleaned metal is coated either by wetting it with gum and then dusting on the enamel in powder form, or direct as a liquid. The coating is first dried in a stove and then heated in a furnace to fusion. Subsequent coats must of course be more fusible than the original foundation coating. They are usually applied by heating the article in a muffle to the correct temperature and dusting the powdered enamel over it while hot. When letters and designs are required, the article is first coated with white enamel, then with coloured enamel suspended in gum water. When dry, the design, which has been cut with a paper stencil, is picked out by removal of the coloured coating, the connecting bars of the stencil being afterwards removed by hand. The article is then fired. The coloured enamel can be applied with a brush to the parts to be decorated, but this is not satisfactory for lettering.

Encaustic, painting in wax. This process is extremely old and is recorded even in Ancient Greece. The method has been used in modern times but largely experimentally. It is said to be more durable than oil painting and the colours are supposed not to fade.

Encephalitis Lethargica, disease due to an infection of the brain by what is believed to be a virus (*q.v.*). The onset is sudden and takes the form of a chill. After a short period of recovery, there is usually some disturbance of vision associated with palsy of the eye muscles. To add to the general symptoms the patient begins to suffer from general muscular weakness and shows signs of a nervous breakdown. This is shortly followed by changes in the normal temperament or demeanour. Finally the patient passes into a lethargic condition which may terminate in death. If death is delayed for more than three weeks the outlook is more favourable although the patient tends to rouse himself from the lethargy each evening and may attempt acts of violence in the night time. Most cases display headache, delirium, coma, muscular spasms and convulsions together with vomiting and mental delusions. No two cases however are exactly alike and whereas death may result in one patient another may have symptoms which are so slight as to escape recognition by any but the expert observer.

Enchanter's Nightshade, a slender herbaceous wild plant of the family Onagraceae with branched downy stem, egg-shaped leaves toothed and pointed and hairy calyx. The roots are creeping. The flowers small white with pink stamens are borne in graceful branched racemes and are succeeded by 2 lobed hairy seed vessels. The plant is common in damp shady places sometimes being a troublesome weed in damp gardens. It flowers in July and Aug.

Enclosures, lands enclosed into private ownership from common land. Commons. ² In sense were lands

owned by one individual in which a whole body of villagers had equal rights of pasture wood gathering etc. Each commoner had a right in every part of the common so that no enclosure was possible either by him or by the owner. Although the Statutes of Westminster and Merton did a little to modify this the position remained much the same until the 18th cent. At that time the population began to increase rapidly and fresh corn land was urgently needed. A movement was initiated to obtain legal sanction for the enclosure of common land in special cases. The first Act was passed in 1709 and this and subsequent Acts were administered on the principle that all commoners should receive enclosed land in proportion to their interest. Enclosure Acts were passed except where they could be proved to be disadvantageous. The number of Acts yearly rose to a maximum of c. 50 in the two decades 1765-85. In 1801 a General Enclosure Act incorporated provisions which standardised the form of private bills and in the same year 119 Acts were passed enclosing c. 300,000 acres.

The movement proceeded with renewed force but died away again towards 1845 when a special commission was set up to examine cases and encourage their presentation. In 24 years another 600,000 acres were enclosed and it has even been calculated that in the century and a half ending in 1869 a total of over 4½ million acres or one-seventh of the area of England was so treated. In the sixties there came a sudden change in public sentiment due to the increasing urbanisation of the country. A great struggle ensued in the London area between the owners who foresaw huge profits from building land and the general public led by a small body of men who afterwards made the nucleus of the Commons and Open Space Preservation Society. The Metropolitan Commons Act of 1866 and subsequent test cases ensured the success of the latter. The preservation movement spread

to the countryside, and in 1876 the Commons Act laid down the new principle that enclosures should only be made when their benefit to the community as a whole could be proved.

Encyclical, a circular letter on ecclesiastical affairs addressed by the Pope to all the clergy and faithful of the Roman Catholic Church.

Encyclopædia This word was defined in Sir Thomas Elyot's *Latin Dictionary* (1538) as "that lernynge whiche comprehendeth all lyberall science and studies". It was first used as the title of a book by Johann Heinrich Alsted in 1608, by which time it had acquired its usual modern meaning of a book covering every branch of human knowledge. The term is also, however, applied to a work confined to some particular branch of knowledge. The distinction between an encyclopædia and a dictionary (*qv*) is that the former explains subjects and the latter explains words.

The compilation of encyclopædias was from a very early date a feature of Chinese culture, and the British Museum possesses an example of one such work in about 700 volumes. Among ancient and mediæval European encyclopædic works, the following are memorable: Pliny's *Natural History*, Isidore's *Origines* (7th cent.), and Vincent of Beauvais' *Speculum majus* (13th cent.). Alsted's *Encyclopædia* (1630) is one of the last written in Latin and arranged non-alphabetically. Alphabetical arrangement was first used in English by John Harris (1704), but the first great English encyclopædia was that of Ephraim Chambers (*qv*) in 1728, a translation of which was the foundation of the famous French *Encyclopédie* (see ENCYCLOPÆDISTS, THE). The first edition of the *Encyclopædia Britannica* was finished in 3 volumes in 1771, and it has been continuously enlarged and expanded in subsequent editions (1778-83, 1788-97, 1800-10, 1817, 1823, 1830-42, 1853-60, 1875-89, 1902, 1910-11, 1922, 1926, 1929). Other important encyclopædias are (in Ger-

man) Zedler's *Universal Lexicon* (1732-54), Brockhaus's *Conversations-Lexicon* (1809-11), in English, *Chambers's Encyclopædia* (1st edition, 1854-62), the *New American Cyclopædia* (1858-63), the *Nouveau Larousse illustré* (1901-4), the great Italian encyclopædia still in course of publication, and similar compilations in nearly every modern language.

Encyclopædists, THE, the name given to those who took part or assisted in the compilation of the French *Encyclopédie*. In 1745 Diderot was asked to help in the production of a French translation of *Chambers's Encyclopædia*, but planned a work on a far larger scale. D'Alembert became associated with the editing, and contributions were secured from such men as Voltaire, Montesquieu, Rousseau, Buffon, Turgot, Quesnay. In the face of many obstacles, the work was finished in 28 volumes in 1772. Under subsequent editors the *Encyclopédie* attained unwieldy proportions and became, in effect, a number of separate dictionaries devoted to various subjects.

Endive, a salad plant of the order Compositæ. The *green-curved* is cultivated for the main crops, as it best endures wet and cold, the *white-curved* is chiefly grown for summer and autumn, the *broad-leaved* is preferred for soups and stews, but is seldom used for salads. A light, dry but rich soil is necessary, deeply dug and unshaded. Seed should be sown in batches from April to early Aug., in drills 12 in. apart, and $c \frac{1}{2}$ in. below the surface. When 1 in. high, thin to 4 in. apart, and transplant when 6 in. high to 12 in. apart. To blanch—take plants 3 months old, fold the leaves round the heart, and tie with raffia and cover entirely with coal ashes.

Endocrine System, a number of separate glands differing in structure and function, but all characterised by the fact that they have no ducts through which to discharge their secretions, but, instead, discharge them direct into the blood-stream (see

GLANDS) The secretions of these ductless glands are called hormones or sometimes endocrines. Their purpose is to regulate the body by governing the processes of growth, general function and reproduction by stimulation or by inhibition according to circumstances and time of life. The more important of the ductless glands are enumerated below together with their situation and their products. Some indication is also given of the processes controlled by each.

Insulin is produced by the pancreas, a gland which secretes digestive juice and discharges it along a duct leading into the bile duct from the liver. Thence a common duct conducts both bile and pancreatic juice into the intestine. In the substance of the pancreas there are however small islets of cells secreting insulin which thus does not find its way into the duct to the intestine. It is discharged direct into the blood stream instead. Because of this dual nature of the

Site	Gland	Hormone(s) Produced	Action of Hormone(s)
In base of the brain	Pituitary gland composed of anterior and posterior parts	Anterior part produces anterior pituitary hormones Posterior part produces posterior pituitary hormones	1 Stimulates growth 2 Regulates growth onset 3 Stimulates the ovary to liberate eggs 1 Stimulates contraction of blood vessels 2 Stimulates contraction of uterus producing labour Regulates heat production of the body Regulates bone formation Regulates storage of glycogen in the liver Adjusts and reinforces the body mechanism in times of anger, combat and flight
In the middle of the neck	Thyroid	Produces thyroxine	Regulates heat production of the body
In the neighbourhood of the thyroid	Parathyroid	Produces parathyroid hormone	Regulates bone formation
In the abdomen	Pancreas	Produces insulin	Regulates storage of glycogen in the liver
In association with the kidneys	Adrenal (Suprarenal) Two parts—adrenal medulla and adrenal cortex	Medulla produces adrenaline Cortex produces a hormone	Adjusts and reinforces the body mechanism in times of anger, combat and flight Increases development of the gland

Each of these glands plays its own part in the bodily process and they also react upon each other. Adrenalin for example acts upon the liver to produce a mobilisation of stores of sugar which are consequently discharged into the blood to supply the muscles. The action of thyroxine on the other hand is to cause sugar travelling in the blood from the alimentary canal to leave the blood and enter the liver. Here the two hormones appear to antagonise each other. In the case of the anterior pituitary hormones and the thyroid there is the reverse condition for these two appear to stimulate each other.

pancreas the hormone producing function for a long time passed unappreciated. The study of the disease known as diabetes at last brought insulin to our knowledge.

Diabetes is a disease in which sugar cannot be stored in the liver or kept in the muscles. The blood is thus overloaded with sugar and is therefore excreted by the kidneys and appears in the urine. This excretion involves the loss of excessive quantities of water from the body and the patient experiences great thirst. When the muscles require sugar to perform exercise there is none in reserve and they therefore become wasted through inadequate

nourishment. The consequence is a thin and emaciated appearance. Yet the patient wants sugar—his appetite is sometimes voracious. But, eat what he will, he continues to lose weight. The cause of all this trouble is that the pancreas is not producing insulin—because the islets of cells have previously had too much work to do. The patient has abused his appetite. Too many carbohydrates have entered the stomach, the insulin has had to be produced in excessive amounts, over long periods, to act upon the liver cells and cause them to store this enormous quantity of sugar until at last the insulin-producing cells have been overtaxed and have given out.

In the thyroid gland, we have a good example of a large endocrine gland, compact, and not complicated, like the insulin cells, with any other kind of gland tissue. The gland consists of two lobes, one on each side of the windpipe, at the root of the neck, joined together in front by a connecting piece of gland tissue. The hormone produced is thyroxin, which has been chemically synthesised outside the body. Iodine is absolutely essential for the production, by the gland, of its hormone. Normal food usually contains sufficient iodine for this purpose, but in some places far removed from the sea, where the soil has been denuded of iodine, the inhabitants are apt to suffer from deficiency of thyroxin. The effect of the thyroxin on the body is to control, in general, all the chemical processes which constitute life. If there is too much thyroxin in the blood, the patient is hot, suffers from perspiration or clammy skin, is highly strung, nervous, suffers from palpitations and loss of weight. In a woman—and it is women who usually suffer from the excess—the monthly losses of blood may be very copious, and anæmia may follow. In addition, a curious feature not yet explained, is that the eyes may become protuberant—a condition

known as *exophthalmos*. Too much hormone in the blood is caused by enlargement and over-activity of the gland, and occurs, in an acute form, in *Graves' disease*. Much relief may often be obtained by the removal of part of the gland. When there is not sufficient iodine in the food, the gland enlarges in an effort to compensate for the deficiency in the amount of thyroxin which it is manufacturing. In this case, the enlarged gland is not over-active for it has raw materials in the form of iodine. Here the patient gains weight instead of losing it, and the condition is known as *myxædema*. When children and infants suffer from lack of thyroxin, they are apt to be so backward in development as to give rise to *cretinism*.

Whether the gland enlarges with resulting over-activity, or with predisposing under-activity, it is called goitre, but the final results in the two cases, *Graves' disease*, and *myxædema* or *cretinism*, are diametrically opposite in their nature. Whereas *Graves' disease* responds to operative removal of the gland, *myxædema* and especially *cretinism* respond to medicinal administration of thyroxin itself.

There are two suprarenal glands, one applied to the surface of each of the two kidneys, and numerous small accessory glands distributed throughout the abdomen. This scattered distribution of gland substance resembles slightly the scattered distribution of the insulin cells in the pancreas. The suprarenal gland tissue, however, is not associated with any other type of duct-discharging gland, but, like the thyroid, is entirely ductless.

It differs from the thyroid in that two hormones are produced by the suprarenal gland, for which purpose the gland contains two different kinds of cell. One type is confined to the centre of the gland, and forms what is known as the medulla, the other is confined to the periphery or surface and forms the cortex.

The medullary cells produce adrenal

lin The secretion of adrenalin is stimulated by impulses travelling to the gland in the *sympathetic nerves* (q1) and when this passes into the blood it acts on certain kinds of muscle in the same way as do the sympathetic nerves. Thus adrenalin augments the action of these nerves with the following results: the heart rate accelerates, the small blood vessels contract, the blood therefore travels more quickly and at a greater pressure. The cells of the liver are stimulated to discharge sugar into the blood stream—the muscles are therefore ready for instant action. The blood supply to the intestines is arrested and the movements of the intestines cease. The eyes dilate. The hair bristles or stands erect. The man or animal is filled with a feeling of courage and his brain is exceptionally alert.

Although the cortex secretes a hormone which is quite distinct yet it nevertheless has something in common with adrenalin in that its effect is upon the male organs of reproduction. It is the hormone of manhood and with its formation and discharge into the blood stream these changes are initiated with which adolescence is associated.

There are two well known diseased conditions associated with the suprarenal glands. One is *Addison's disease* or bronze diabetes. This disease has no connection with insulin diabetes but great muscular weakness is common to both. Addison's disease is resultant upon a failure of adrenalin production. There seems to be some diversion of the raw materials for instead of being turned into adrenalin they are deposited in the skin, giving it a characteristic bronze coloration. The other disease is caused by an overgrowth of the cells of the cortex. Adolescence is early, the boy's habits become sexually precocious and even criminal.

Other endocrine glands of particular interest are those concerned with the regular female sex organs.

(see REPRODUCTIVE SYSTEM) The parathyroid glands have been mentioned here but further reference should be made to the article on BONE.

The only other gland of special note is the pituitary but the present state of our knowledge about this is not very extensive. As will be seen from the table above it produces some hormones which play a part in the working of the ovary and some which have a part in common with the parathyroid in the formation of bone. There is a disease known as *acromegaly* in which the head becomes very large and the hands and feet also become abnormally big. Patients complain of suddenly having to obtain larger hats, gloves and boots and often too of having to procure new sets of false teeth because the previous set has become too small. These patients usually become sexually impotent but the cause of the condition is not in a disturbance of the sex hormones so much as of the bone-producing one. Possibly the cells of this latter type grow and replace the cell of the former for the disease is always associated with the formation of a large tumour in the pituitary gland.

Endogen archaic name for the Monocotyledonous group of plants which refers to the structure of the vascular system which consists of strands of ligneous tissue isolated in a cylinder of cellular tissue.

Endosperm (bot) nutritive tissue in seeds which feeds the growing embryo.

Endowment Insurance, form of insurance whereby in return for regular contribution a fixed sum is payable at death or at a certain age when the insured person ceases to pay premiums. In the latter form it is a common way of saving against old age. See also INSURANCE.

End-stopped, a term applied to those lines of blank verse (q1) the end of which coincides with the end of a clause or to a heroic couplet (q2) which is grammatically complete and self-contained. See also E.

Enduro, name given to certain ferrous alloys which are very resistant to the action of acids and other corrosive media. The principal constituent is chromium, which is present in amounts of about 15 per cent, small amounts of other elements such as nickel, manganese, silicon, and carbon are also incorporated. *See also ALLOYS*

Endymion [ENDI'MIŪN], a shepherd in Greek mythology, beloved by Diana or Cynthia, goddess of the moon. In response to her (or, perhaps, his) prayer, Jupiter made him immortal that he might sleep as much as he desired, hence the classical phrase "to sleep the sleep of Endymion," and the title of the famous poem of Keats (*q v*)

Energy. The notion of energy as a real entity seems natural to-day, since we are accustomed to seeing it bought, sold, and transformed from one form to another. The clear conception of the nature of energy is due to Robert Mayer, a German physician, who stated the doctrine of the *conservation of energy* in 1842 *viz* "The quantity of energy in the universe is constant, none is ever destroyed or created." The fact that this central doctrine of modern physics was discovered so late, is due to the fact that force, and not energy, appeared to physicists to be one of the two primary notions of physics, the other being inertia (*see DYNAMICS*)

Energy is divided for convenience into two forms, potential and kinetic, potential energy being energy stored in a motionless system, as when a weight is raised above the surface of the earth, a spring stretched, two substances such as carbon and oxygen separated, electrical energy stored in a condenser, and so on. Kinetic energy is energy of motion, and is contained in a moving mass, or a beam of radiation. This distinction is of less importance than the distinction between available energy and non-available energy. The transformation of one kind into another is never accomplished without the "degradation" of some part of the

energy into low-temperature heat, which can be re-transformed into some other kind of energy only if a means of allowing some of it to flow away at a still lower temperature is available. In an analogous way, the water of the sea contains a great deal of potential energy, if we consider that it is nearly 4000 m from the earth's centre, towards which it is attracted, and would fall if a shaft were opened for it to fall down. But without a "bottomless" pit, we can make no use of this vast store of energy.

Modern civilisation depends for its existence upon sources of available energy. The practical side of this problem is dealt with in the article **POWER, SOURCES OF**

It has recently been shown that mass and energy are not two entirely separate and distinct fundamental entities, but that energy itself has mass, the mass of a given amount of energy being found by dividing it, expressed in absolute units, by the velocity of light. This applies to energy of all kinds, hence a moving body is slightly heavier than one at rest, a stretched spring heavier than the same spring relaxed. It follows that if material particles could be annihilated, energy would be emitted, no doubt in the form of radiation. This has been suggested as the source of cosmic radiation (*q v*). The relation between heat and other forms of energy is the subject of the science of *thermo-dynamics* (*q v*)

Energy in its mechanical form is expressed as the product of a force into the distance through which it moves. The absolute unit of energy used in physics is the *erg*, which is the work done by unit force (1 *dyne*) operating over a distance of 1 centimetre. For practical purposes a unit 10,000,000 times as great is employed, called the *joule*. The electrical unit of power, the *watt*, is defined as the power which consumes 1 joule per second. Heat energy is measured by the *calorie*, which is the amount of heat necessary to raise 1 gramme of water 1° C in temperature (at about 16° C). The legal British

Thermal Unit is the amount of heat required to raise 1 lb of water 1° Fahrenheit. One calorie is equal to 4.18 joules. One British Thermal Unit is 252 calories. Another practical unit of energy much used by engineers is the *kilogramme metre* the work done in raising a kilogramme weight through the height of 1 metre against the force of gravity. The corresponding British unit is the *foot pound* the work done in raising 1 lb through 1 ft height. The British unit of power is the *horse power* which does work at the rate of 550 ft lb per second. A common derivative of this is the *horse-power hour* which is a unit of energy. The horse power is equivalent to about 746 watts. The common electrical unit of energy is the *watt hour* known in Britain as the *Board of Trade Unit*. This is equal to 3600 watt hours (3.6 kilowatt hours). One Board of Trade unit or kilowatt hour is equal to 1.34 horse power hours. 3410 British Thermal Units and 838 kilocalories (1000 small calories). One horse power hour is equal to 2545 British Thermal Units.

Enfilade (*Fr enfiler* to thread) in military phraseology firing directed along the length of the enemy's line or trench instead of across it. It is particularly destructive since each shot is potentially effective over a greater length of its flight.

Engadine largest and most elevated of alpine valleys running N.E. to S.W. in the S.E. portion of Switzerland. It lies between the Albula and Bernina chains and is watered by the Inn a large tributary of the Danube which it joins at Passau. The Upper Engadine 24 m long with the upper valley of the Inn forms part of the Grisons. There is no agriculture only hay and pasture. The important centres are St Moritz, Sals and Samaden which last named gives a fine view of the Bernina group. At St Moritz there are winter and summer sports.

The Lower Engadine is less elevated and has a more luxuriant vegetation. It is the capital (pop 10,000) of the Engadine. It has many mineral springs.

There are 12 communes in the Lower Engadine which supports about 10,000 people. Here is the Swiss National Park covering 54 sq m near Zernez a preserved area founded in 1909 as a sanctuary for animals birds and vegetation.

Engaged Column (archit.) a column partly embedded in a wall usually found in colonnades. Rare in classical Greece it became common in Roman architecture as shown in the Colosseum. It was employed in Gothic churches to form clustered piers and in Renaissance buildings.

Engels, Friedrich (1820-1895) German Socialist and writer son of a wealthy cotton spinner at Barmen. He early took a keen interest in philosophy and contributed letters to radical periodicals. At the age of 21 he was sent to his father's factory near Manchester where he came into contact with the Chartist movement and wrote for the *Northern Star*. When he met Karl Marx (*qv*) in Paris in 1844 the two men were already in agreement in their ideas and their close collaboration and friendship persisted until the death of Marx. It was largely through Engels' financial assistance that Marx was able to carry on his work. Engels gained practical revolutionary experience in the 1848 Baden uprising and subsequently returned to England where the rest of his life was spent. He collaborated with Marx in writing *The Communist Manifesto* and other works edited and completed vols II and III of *Capital* and himself wrote many fundamental contributions to Socialist theory among which may be mentioned his *Condition of the Working Class in England* and his *Origin of the Family Private Property and the State*. The greater part of his writings has been published in English translations.

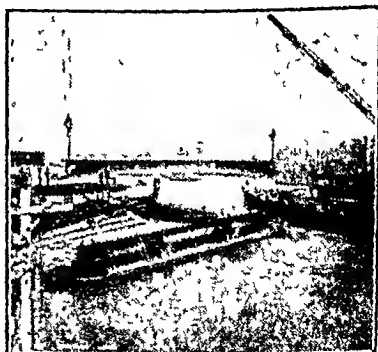
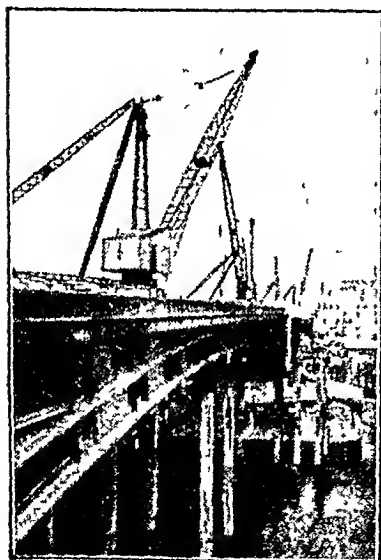
Enguien [ON GR ON] town in the Belgian province of Hainaut a centre of the lace industry. Condé the French general of the 17th-cent. Spanish wars who bore the title of Duc d'Enguien resided here. The

afforded hospitality to both J J Rousseau and Voltaire Pop c 5000

Engineering. The engineer is concerned with the application of physical science to useful ends, but draws upon a large store of purely empirical experience, which has not yet been allotted its place in pure science. The term is usually confined to physical practice as opposed to purely chemical, the chemical engineer being concerned with the machines and other apparatus used for carrying out chemical reactions on a large scale rather than with these reactions themselves. The engineer was originally purely military in his functions. He was charged with the construction of "engines" of warfare, and with work such as the building of roads and fortifications. Hence the first professional engineers who applied their powers solely to peaceful purposes, such as the construction of roads, bridges, and canals, were known as *civil engineers*,

this title is now confined to work of this type. Mining engineering is concerned with the obtaining of valuable minerals, and all other branches with the application of available materials and sources of energy to various useful purposes. The branches of engineering are continually growing in number, some of the most recent being concerned with aerial navigation (*Aeronautical Engineering*), and the use of wireless (*Radio Engineering*). This tends to the multiplication of technical societies, institutes, and institutions devoted to specialised branches of the subject, many of these are given under **SCIENTIFIC AND TECHNICAL SOCIETIES**.

The study of engineering demands a natural practical aptitude combined with the power of grasping scientific principles, there is to-day hardly any branch of engineering in which the principles of modern science do not find application, often of a highly mathematical character. But the engineer operates not only with formulæ based on first principles, but with *empirical formulæ*, which represent cases where practice has outstripped theory. These formulæ are derived from elaborate experiments, often carried out on a large scale, they describe the properties of materials, or their behaviour under certain conditions, too complicated for calculation.

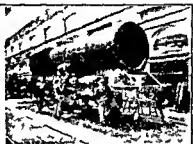


The Lambeth Bridge in construction, one of the series of Thames bridges built in recent years

on Since each engineering problem in some respects new practical experience is indispensable to the engineer for no textbook or laboratory training can tell him the conditions under which any particular theory or formula is applicable in practice For this reason the experienced practical man frequently has an advantage over the inexperienced man with a more elaborate training though the greatest

Army equipment and artillery the construction of roads and bridges was also allotted to them

A body of military engineers had their headquarters in the Tower in the 14th cent and were employed at the sieges of Calais (1346) and Harfleur (1415) Under Henry VIII a corps of pioneers was organised and in the 17th cent the King's Engineers were entrusted with the fortifications of the



The building of the Royal Scots engine

achievements in engineering are the work of engineers who combine theoretical knowledge with experience

Engineers Military that branch of an Army which specialises in the application of engineering to warfare From the earliest times engineers were concerned with the making of weapons for throwing projectiles from the 14th cent onwards they were also engaged in the building of military fortifications and later still in the increasing weight and size of

country In 1716 the engineers and the artillery were finally separated and in 1787 the former took their present title of the Royal Engineers

In the World War the Royal Engineers were largely occupied with mechanical and scientific development their strength increasing from 2 per cent of the Army in 1914 to 14 per cent Early in the War 13 companies of engineers were attached to each infantry brigade and 3 to each train to each

the cavalry, and various units to the base. Later, units were formed for special duties such as drainage, water-supply, tunnelling, etc. Other important duties of the engineers from 1914 to 1918 include chemical and poison-gas experiment, searchlights, surveying, camouflage design, and, indirectly, the control of tanks and all mechanical forms of transport. A transport branch, formed in 1916, supervised railways, roads, waterways, ports, docks, and the Channel ferry. The supply of engineering stores, and their transport from England, was another huge task undertaken by the Royal Engineers.

Since the World War the Signallers have been separated from the Royal Engineers. The peace-time strength of the latter is c. 1100 officers and 7700 men. They co-operate directly with the General Staff. Military engineers are intensively trained at Cambridge, the School of Military Engineering, and with commercial engineering firms.

England, that part of the British Isles lying S of Scotland and E and S of Wales, it is the richest and most thickly populated part of Great Britain, and the mother-country of the British Empire. It is separated from France by the English Channel, from Belgium and Holland by the North Sea, and from Ireland by the Irish Sea, the Cheviot Hills and the R. Tweed divide it from Scotland, and an artificial boundary along its W. counties from Wales. Area, 50,875 sq m., pop. (1931), 37,354,917.

Coast-line is much broken, and provides a number of fine bays and excellent natural harbours, the mouths of the greatest N. and S. rivers, the Humber and the Mersey, and the Thames and the Severn, are respectively almost opposite each other. The structure of the coasts varies considerably between granite cliffs, chalk, shingle, and along the fenland coast, marsh. Among the notable bays and inlets are Morecambe Bay, the Mersey and Dee mouths, the Severn, Barnstaple and Falmouth Bays, Plymouth

Sound, Southampton Water, the Thames estuary, the Wash, and the mouths of the Humber, Tees, and Tyne; and world-famous ports include London, Liverpool, Bristol, Plymouth, Southampton, Portsmouth, Dover, Hull, and Tynemouth.

There are several islands around the coasts, of which the most important are the Isle of Man, the Scilly Isles, and the Isle of Wight.

Relief. This may be best considered by dividing the country into the N., W., S., and Midland regions. The two outstanding features of the N. are the Pennine Chain, and the mountains of the Lake District. The Pennines extend from the extreme N. to the Midlands in an almost straight line between Tyne Gap and the lower Trent, rather to the W. of the centre of the country, the W. slopes are sharper than the E. Notable peaks of this system are Cross Fell (2900 ft.), Mickell Fell (2500 ft.), Knock Fell (2600 ft.), Wharfedale (2400 ft.), Ingleborough (2370 ft.), and Pen-y-ghent (2300 ft.). Much of the land is above 2000 ft. high, and the district is largely covered with bare, bleak moorland. The Pennines are divided into N. and S. sections by the Aire Gap, the S. is generally lower, though in the Peak district of Derbyshire, Kinder Scout and the Peak are noteworthy. On the W. of the N. Pennine system are the mountains of the Lake District (*see* CUMBERLAND, WESTMORLAND), a district of great natural beauty; the outstanding heights are Scafell Pike, Scafell, and Helvellyn all over 3000 ft. To the E. of the Pennines the Cleveland Hills and N. Yorkshire moors are divided by the R. Esk, and S. of them are the S. Yorkshire Wolds. On both sides of the Pennine region are considerable plains, including the Solway, Morecambe, and Cheshire plains on the W., and the Vale of York, widening into the beginning of the great E. Plain, on the E.

The S.W. mountains (*see* CORNWALL, DEVON) include the high central Cornish ridge, separated by the Tamar

valley from the heights of Devon Dartmoor and Exmoor which lie S and N of the Devon Plain. The hills of the S and Midlands viewed from Somerset and Dorset resemble four great fingers from the Mendips the Cotswolds extend N.E. through Edge-hill to the Northamptonshire uplands which terminate in the E. Plain just to the S the White Horse and the Chilterns move S and E to the East Anglian ridge and in the extreme S the Blackdown Hills and the W Downs divide in Hampshire into the N and S Downs. The whole of this S and Midland system is an alternation of hills and plains which include the upper and lower Thames valleys the Somerset Selsey and Salisbury Plains and the vales of Dorset Sussex and Kent.

The Midland plateau separates the Pennines from this system E of the S Pennines and extending S almost to the lower Thames valley the great E. Plain cover Lincs Cambs Norfolk and Suffolk Hunts Essex and parts of counties just W of them.

Geology. Geologically England is interesting as exhibiting almost every kind of known formation on or near the surface and for having given the name to such well known systems as the Cambrian Devonian (q.v.) etc. The Pennines are mainly Carboniferous and date from that period there are some limestone areas with interesting cave formations. The Lake District mountains are volcanic rocks and slates. The W system consists of folded beds of Devonian rocks and quantities of granite with a variety of carboniferous rocks and the hill of the S and S centre are mainly chalk with outcrops of older rocks in the Mendips.

Rivers. The rivers for the most part can be associated with the systems. From the Pennines there flow N.W. the Eden S.W. the Lune Ribbles Mersey E. the Tyne Wear Tees Aire and Wharfe and from the S the Derwent. The Severn rises in Wales and flows between the S. Shropshire hills and the Midland

plateau turning slightly W to conform with the direction of the Cotswolds. The Trent rises in the N. Staffs hills and flows E and N to the Humber. In the W the most notable rivers are the Tamar Exe Dart and Camel. The Thames (q.v.) is the great river of the system to the S of it is the Medway and many minor streams flow into the English Channel. In the E. Plain the Len district includes the Ouse Little Ouse Cam Witham and others. Except for those in the Lake District there are no important lakes.

Natural Resources. considering the comparatively small area of the country are remarkable minerals are of outstanding value and in order of importance easily the first is coal of which over 100 million tons including Welsh coal are raised annually while there is still an estimated reserve with in 4000 ft. of the surface of nearly 200 000 million tons. Iron-ore comes from Cleveland N. Lancs and Staffs tin from Cornwall lead from Yorks Cumberland and other N. counties chalk from Kent and other S. counties copper from Cornwall and salt slate and stone of various kinds from nearly all over the country except the E. plains. All these minerals are of varying but considerable commercial value. To these natural mineral resources should be added the fertility of the soil the rich fisheries the many useful rivers giving an abundance of water power and the commanding geographical position of the country. The vigour and thrift of the people their commercial seafaring and inventive genius and the favourable climate have also played an outstanding part in British development.

Industries. English industries are so numerous and so varied that it is simplest to consider them according to districts. In the N.E. the presence of coal and iron fairly close together leads to the shipbuilding engineering and general metallurgical industries that centre in such towns as Newcastle Sunderland S. and Middlesbrough are carried

on at Barrow-in-Furness, stimulated by the Cumberland coalfields, though of these the Whitehaven mine has experienced serious disasters of recent years. Further great coal deposits between S Lanes and the W Riding give us the manufacturing towns of Leeds with a wide variety of trades, Barnsley, Wakefield, Halifax, and Bradford, centres of the woollen industry, and in S Lanes the great cotton towns of Manchester, Bolton, and Oldham. Other manufacturing towns grouped around the S Pennines are Doncaster and Sheffield, and farther S Derby, all noted for steel and engineering, Warrington, Stockport, Preston, Wigan, and Bury, with manufactures of cotton, machinery and chemicals, and farther S the Potteries Nottingham, famous for its lace and hosiery, is practically the most S of this great N group. In the Midlands, another industrial district, "the Black Country" centres around Birmingham, and this and the neighbouring towns of Coventry, Wolverhampton, Dudley, and Walsall are all noted for motor-cars, bicycles, and all kinds of steel goods. In the S and E there are no great masses of industrial centres with the exception of London and its environs, but various isolated towns have local industries. Leicester and Northampton are well known for hosiery and leather goods, Eastleigh, Swindon, and Peterborough are all notable railway centres, and Norwich has large general manufactures. In spite of this, however, there has been, in the last few years, a quite decided expansion of industry in the South. Reading has enormously increased in size, the growing English film industry is settled not far N of London, Oxford is notable for motor-car factories, Luton, Aylesbury, Slough, Willesden, Watford, and the area directly E. of London, all have considerable industrial activities. It is worthy of note that more than one-third of all the factories recently established in England were set up in or near Greater London.

Some approximate figures will be illustrate the great size and scope of English manufactures. The total exports of 1932 were valued at nearly £420 millions, and the gross output of the more important industries was (for Great Britain as a whole): coal 243,882,000 tons, iron, 11,627,200 tons, steel, 7,325,700 tons, salt 2,067,564 tons, engineering £18 millions, woollens, £111 millions, textiles and clothing £130 millions, brewing and malting £140 millions, shipbuilding £57 millions, and printing of all kinds £105 millions.

There is scarcely a country in the world with which England does not trade, and in consequence a prolonged period of depression makes conditions more difficult than would be the case in a more self-contained country.

Another pre-eminent source of wealth lies in the shipping trade. The English mercantile marine has long held a leading place, and, though labouring under difficult conditions, is still one of the great carrying services of the world, both of passengers and goods.

Fisheries are of such value as to command special mention, the great Dogger Bank district, which has made the port of Grimsby, the Lowestoft herring fisheries, and the huge catches of pilehards off the Cornish coasts may be noted, as well as the quite considerable fisheries of the S. Cod, herring, haddock, pilehard, and hake are the largest catches, and the total value of sea fish caught is more than £10 millions annually. The building of fishing craft, the making of nets, fish-curing and packing, also provide work for great numbers of men.

Agriculture Since the Industrial Revolution of the early 19th cent. a decline has taken place in English agriculture, at first very gradual, but of late years sharply accelerated. The movement of the rapidly growing population towards the industrial towns, and the competition from the great grain- and food-producing countries have contributed towards this end.

But at the same time the climate and the fertility of much of the soil should enable home products to be considerably more widely cultivated than they are especially as the quality of such commodities as meat fruit vegetables and wheat is beyond question. Considerably more space is given over to pasture than to arable land the ratio being about 12 to 8 the number of sheep raised (c. 18 millions) is far greater than the number of cattle (c. 6 millions) while horses do not reach a million. Of the crops the largest are wheat oats and barley of which the production of oats is the greatest the area under all vegetables is about the same as that under any one of the grain crops orchards cover c. 2,000,000 acres and hops c. 200,000 acres.

The distribution of the agriculture is rather difficult to describe as except for the large grain producing areas in the East the products are not at all clearly defined into districts. The East can produce all crops and has considerable pasturage areas on the East coast and provides most of the rough grass of Devon Somerset and Cornwall are famous for fruit and dairy farms and Cheshire Herefordshire and Gloucestershire are noted for cattle and sheep. Considerable efforts have been made since the World War to convert farmers and put agriculture on a better commercial basis.

Climate varies considerably but only occasionally reaches extremes of heat or cold and there is a good average rainfall. Oct. is usually the wettest month. As a whole the climate is favourable both to industry and agriculture and the country is of agricultural and the coasts are devoted to fishing.

Fishes and Farms. The large cod fishery and great development of the herring have attracted visitors from all parts of the world. There are three hundred and thirty thousand acres of farmland and the produce is well known to the world. The land is well watered and the soil is fertile and well known to the world.

There are many districts in England and the soil is fertile and the climate is good. The land is well watered and the soil is fertile and the climate is good. The land is well watered and the soil is fertile and the climate is good.

Commonwealth. The railways in the 4th and 5th years of the 19th century were built and the land is well watered and the soil is fertile and the climate is good. The land is well watered and the soil is fertile and the climate is good. The land is well watered and the soil is fertile and the climate is good.

Religion. The Church of England (c. 10 million) is the majority and the land is well watered and the soil is fertile and the climate is good. The land is well watered and the soil is fertile and the climate is good. The land is well watered and the soil is fertile and the climate is good.

Education and Culture. There is a national system of education from 5 to 16 years and many children are sent to boarding schools. There are a number of famous universities and some of which are in the north. The most famous universities are at Oxford Cambridge and London and there are several others in the great cities of the country. The land is well watered and the soil is fertile and the climate is good.

hall School (London), and Manchester College are among the famous musical schools. The cost of education is one of the heaviest items in the Civil Estimates. Separate articles deal with the literature, art, and music of the country, as well as with its History, Constitution, Local Government, and general administration. See also articles under the names of the English counties, towns, etc.

England, Church of, the established Church in England, subject since the Reformation to State supremacy in temporal matters. It traces its descent without a break from the ancient British Church. In doctrinal matters the Church stands between the Roman Catholics and the more extreme reformed Churches. In addition to the general teachings of Christianity (*qv*), the Church in its principal doctrinal formula, the Thirty-Nine Articles (*qv*), accepts the doctrine that while justification of sinners can only be achieved by faith, the two sacraments of Holy Baptism and the Lord's Supper are, as the Catechism puts it, "generally necessary to salvation." While rejecting the doctrine of transubstantiation, the Articles teach that the Sacrament of the Lord's Supper is in a peculiar sense a rite of communion with Christ and with the whole Church. Much of the elaborate ritual of the Pre-Reformation Church was abolished by the State in authorising the Book of Common Prayer. But the Church of England allows itself more ritual than most Protestant churches. The Church accepts the doctrine of Apostolic succession, rejecting both the Presbyterian and Congregational form of government on theological, not practical, grounds. It is in communion with several other Churches, as for example the Swedish Church, and is only less formally so with the Eastern Orthodox Church.

The views of the Church, as stated in the Thirty-nine Articles, are probably held to-day by only a portion of the clergy or laity, as the majorities in favour of Prayer Book

revision in 1928 showed. Some sections of the Church embrace extreme Catholic tenets, holding the doctrine of the Real Presence of Christ in the elements of the Lord's Supper, and having a ritual almost as elaborate as that of the Roman Church. Others approximate more to Protestant Non-conformity both in doctrine and practice. Still others hold modernist doctrines which would shock equally the Evangelical and Catholic sections of the Church. It is the especial genius of the Church of England that it can contain such diverse elements mainly by the power of its tradition and by its practical toleration.

The Anglo-Catholic movement is largely represented among the clergy, but the bulk of the laity remain Protestant. The House of Commons rejected the proposed revision of the Prayer Book (1928).

In government the Church is episcopal, being divided into two archbishoprics, Canterbury and York (the Archbishop of Canterbury is the primate of All England), in their turn subdivided into dioceses and again into parishes, the latter being grouped together into rural deaneries. In doctrine, subject to the supremacy of Parliament, the two convocations (*qv*) of York and Canterbury are supreme; in other ecclesiastical business the legislative body is the Church Assembly (*qv*).

The history of the Church in England reaches back to the days of the Roman occupation. The Church was then in communion with Rome, but the Anglo-Saxon invasions severed communications, and the British Church tended to develop along separate lines. After the conversion of the Anglo-Saxons by the efforts of the British missionaries, mainly from the monastery of Iona, and by missionaries sent from Rome to convert the heathen and to bring the British into the Roman fold, conflict arose over differences of usage. The victory of Roman over British usage pointed the way for the develop-

ment of the Church in England. Its structure was henceforth episcopal rather than monastic and its usages with minor differences were to follow Rome.

The Mediaeval English Church from the Roman victory over the Brits until the Reformation was part of the Christian Church in the West and its doctrine and ritual participated in the common development (see CHURCH HISTORY). The main interest of English Church history in this period lies in the relations between Church and State and between the Papacy and the Church in England. In conflict with the State the Church in England at first worked in alliance with the Papacy. The power of the Church was checked by the growing centralisation of justice under Henry II. Later the Church is to be found in conflict both with the Crown and the Papacy, particularly in the reign of Henry III. Then and during the time of the Avignon Popes the Papacy was attacked because of its financial exactions. Later Church and State became allied against the Papacy. From Catholics who were also Nationalists came the breach with the Papacy in 1534.

In England the Reformation followed rather than preceded the breach with Rome. The Church in England contained both a Catholic and a reforming party and the official doctrines laid down in the Prayer Book of 1549 after the temporary victory of the extreme Puritans are a compromise. The successive Prayer Books from 1549 show the increasing influence of the Reformers but with the Restoration came a reaction against the Puritan victory of the Commonwealth and a slightly more Catholic expression of doctrine. The High Church party lost ground considerably after the Glorious Revolution and the accession of William and Mary to the throne. Throughout the 18th cent the Low Church party remained supreme. In the later 18th cent controversy against

the assaults of the deists and the suppression of Convocation which seemed about to condemn Bishop Hoadly for heresy, an event the Government did not desire were all that showed that the Church was alive. The Methodist revival at the end of the century bringing at first new strength and enthusiasm resulted in the withdrawal of the Wesleyans to form a Nonconformist group. In the 19th cent there came a High Church revival in the Oxford Movement (qv) and as a reaction to this the evangelical movement in the Church. Controversy between the Evangelicals and the Anglo-Catholics marks the latter part of the 19th cent and the days before the War.

The main features of recent years have been the growth of the Anglo-Catholic movement in spite of prosecution, the growth of modernism (qv), the increased activity of Convocation and a considerable number of reforms in Church government culminating in the Enabling Act of 1919 (qv) and the controversy over Prayer Book revision.

Consult: *A History of the English Church* ed Stephens and Hunt in 8 vols. H. O. Wakeman *An Introduction to the History of the Church of England* (1896). *The Future of the Church of England* ed Sir J. Marchant.

England Sovereigns of

SAXON AND DANISH KINGS

Egbert	827-39	
Ethelwulf	839-58	Son of Egbert.
Ethelbald	838-60	Son of Ethelwulf
Ethelbert	860-66	2nd son of Ethelwulf
Ethelred I	866-71	3rd son of Ethelwulf
Alfred the Great	871-900	4th son of Ethelwulf
Edward the Elder	900-5	Son of Alfred
Athelstan	925-40	Son of Edward
Edmund	940-6	4th son of Edward

Edred 946-55 5th son of Edward
 Edwy 955-8 Son of Edmund
 Edgar 958-75 2nd son of Edmund
 Edward the Martyr 975-9 Son of
 Edgar
 Ethelred II (the Unready) 970-
 1016 2nd son of Edgar
 Edmund Ironside 1016 Son of
 Ethelred II
 Canute (Cnut) 1017-35
 Harold I 1035-40 Son of Cnut
 Hardicanute (Harthacnut) 1040-2
 Son of Cnut
 Edward the Confessor 1042-66
 5th son of Ethelred II
 Harold II 1066 Brother-in-law of
 Edward the Confessor

SOVEREIGNS SINCE THE CONQUEST

House of Normandy

William I 1066-87
 William II 1087-1100 3rd son of
 William I
 Henry I 1100-35 Youngest son of
 William I
 Stephen 1135-54 Grandson on his
 mother's side of William I

House of Plantagenet

Henry II 1154-89 Grandson on his
 mother's side of Henry I
 Richard I 1189-99 Son of Henry
 II
 John 1199-1216 6th son of Henry
 II
 Henry III 1216-72 Son of John
 Edward I 1272-1307 Son of Henry
 III
 Edward II 1307-27 Son of Ed-
 ward I
 Edward III 1327-77 Son of Ed-
 ward II
 Richard II 1377-99 Grandson of
 Edward III

House of Lancaster

Henry IV 1399-1413 Son of John
 of Gaunt and grandson of Edward
 III
 Henry V 1413-22 Son of Henry
 IV
 Henry VI 1422-61 Son of Henry
 V

House of York

Edward IV 1461-83 Great-great-
 grandson of Edward III
 Edward V. 1483 Son of Edward
 IV
 Richard III 1483-5 Brother of
 Edward IV.

House of Tudor

Henry VII 1485-1509 Descended on
 his mother's side from Edward III
 Henry VIII 1509-47 Son of
 Henry VII
 Edward VI 1547-53 Son of Henry
 VIII by Jane Seymour
 Mary 1553-8 Daughter of Henry
 VIII by Catherine of Arragon
 Elizabeth 1558-1603 Daughter of
 Henry VIII by Anne Boleyn

SOVEREIGNS OF GREAT BRITAIN AND
IRELAND*House of Stuart*

James I (VI of Scotland) 1603-25
 Son of Mary Queen of Scots, de-
 scended from Henry VII.
 Charles I 1625-49 Son of James I
 Commonwealth 1649-1660
 Charles II 1660-85 Son of Charles
 I
 James II 1685-8 Brother of
 Charles II
 Interregnum 1688-9
 William III 1689-1702 Grandson,
 on his mother's side, of Charles I,
 and husband of—
 Mary II 1689-1694 Daughter of
 James II
 Anne 1702-14 2nd daughter of
 James II

House of Hanover

George I 1714-27 Great-grandson,
 on his mother's side, of James I
 George II 1727-60 Son of George
 I
 George III 1760-1820 Grandson of
 George II
 George IV 1820-30 Son of George
 III, Regent 1811
 William IV 1830-7 3rd son of
 George III
 Victoria 1837-1901 Grand-
 daughter of George III

House of Saxo Coburg

Edward VII 1901-10 Son of Victoria

House of Windsor

George V 1910 2nd son of Edward VII

Engleheart, George (1852-1839) English miniature painter & as a pupil of Reynolds and became one of the most popular miniature artists of his time rivalled only by Cosway. He painted numerous portraits of George III and also copied in miniature the paintings of Reynolds.

His nephew **John Cox Dillman Engleheart** (1783-186) was also a well known miniaturist.

English Channel, narrow sea between France and England extending for c. 300 m. from the Scilly Isles and Ushant to the Straits of Dover. In the W it flows into the Atlantic and in the N.E. into the North Sea. Chief islands are the Isle of Wight and the Channel Island and the only river of importance is the Seine. The English Channel covers what was once a great valley between England and France. See also CHANNEL TUNNEL.

English History though strictly dating from the invasions of the Angles, Jutes and Saxons in the 5th cent. may reasonably be carried back to the Roman occupation of A.D. 43. It thus covers a period of almost exactly 2000 years divided into two roughly equal halves by the Norman Conquest in 1066. During the first thousand years England appears to have been the happy hunting ground of marauding tribes suffering a series of armed invasions many of which assumed the character of permanent occupation. Following the Norman conquest this situation was fundamentally changed and though she from time to time suffered the influx of foreigners or of native adventurers many of them were welcomed or at least endured for no nation since then has ever succeeded in planting the invader's foot in the land. The nearest approach to foreign interference

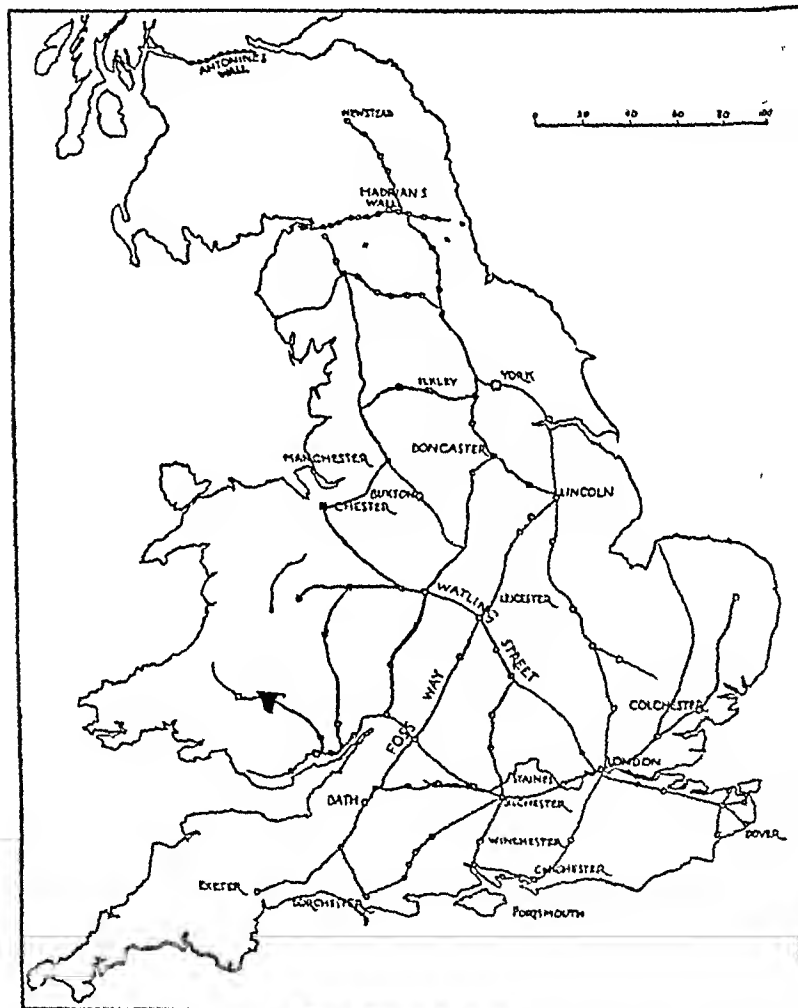
with English affairs may perhaps be seen in the curious spectacle of a Dutch prince on the throne of England in 1689 and in the series of German kings in the 18th cent. Since the time of Elizabeth England has penetrated into every one of the continents and her success in the field of colonisation and expansion may be gauged by the extent of the British Empire as it exists today.

Period of Invasions When the Romans began their serious conquest of Britain nearly a hundred years after the reconnaissance by Julius Caesar they found the Celts in possession of the island. These Celts were akin to the Gauls of France and N. Italy a race which had sacked Rome, invaded Greece and penetrated (as Galatians) into Asia Minor. In Britain there appear to have been two distinct branches each speaking its own language or dialect. At the head of a loose confederacy was a king called Cunobelin (Cymbeline) who reigned at Camulodunum (Colchester). That he was no stranger to Roman civilisation is shown by the fact that his coins 40 varieties of which have been preserved bear the title Cunobelinus Rex. His son Caractacus and later on Boadicea the warrior queen of the Iceni offered a vigorous resistance to the invaders but in a few years Rome was in possession of all Britain as far as the Humber in the N. and the Severn in the W. Agricola who landed in 83 extended the Roman dominion to the Grampians and transformed the conquered territory into a Roman province. No attempt appears to have been made to subdue Scotland. In total two lines of forts were built from the Forth to the Clyde and from the Tyne to the Solway. The more S. line was later developed by Hadrian into the Roman Wall.

For the next 300 years Britain continued to be a Roman province enjoying a period of peace and prosperity seldom equalled in after years. At the outset the Roman rule was doubtless a military occupation. The Roman

cities, many of which survive to this day, were military strongholds, and the Roman roads which covered the country were military roads. After a time, however, civilisation advanced

under the protection of the Roman legions. The newly founded cities brought trade, and the military roads could be, and doubtless were, used for peaceful as well as for warlike traffic.



Roman Roads in England

All over the country prominent Roman officials built their villas and cultivated their estates. In and about the cities and along the line of the great roads the conquered population assimilated the culture and probably spoke the language of their conquerors. Many of them became Roman citizens. It was only in the remote country districts that the Celts remained whole heartedly Celts. After c. A.D. 300 Christianity was introduced. Roman churches were built and Roman bishops appointed.

It is not however to be supposed that Roman Britain remained entirely undisturbed by marauders from overseas and that the virile tribes from the other side of the North Sea quietly waited for the Romans to go before they began to plunder the coasts of Britain. The appointment of a Count of the Saxon Shore proves that Roman Britain was not entirely immune from Teutonic raiders and that vigorous steps must have been taken to deal with the problem. Nor can the unconquered Picts and the Irish Scots have remained completely inactive during this long period.

In A.D. 410 a variety of causes led to the Roman evacuation of Britain and the dismayed inhabitants were left to their own devices. Deprived of the powerful support of the Roman legions they soon had to cope not only with their unconquered kinsmen in Scotland but with the venturesome barbarians of N. Germany and Denmark. These tribes disturbed by the movement of the other barbarians who were threatening the existence of Rome were roused out of their quiescence or at any rate were impelled to find a new outlet for their activities. In 449 scarcely 40 years after the last Roman legionary had left Britain the first Jutes led by Hengist and Horsa landed on the Isle of Thanet. The story that the S. Britons called them in to help them against the Picts is now largely discredited. The example of the Jutes was followed by the Angles from

Slesvig and the Saxons from Holstein. The Jutes confined themselves to Kent and the Isle of Wight, the Saxons settled S. of the Thames and the Angles occupied the E. coast as far N. as what is now Northumberland.

The events of the next 150 years are very obscure but it appears that the fabric of Roman civilisation was destroyed. According to some authorities the Anglo-Saxons poured into the country in vast numbers reaching as



The Saxon Kingdoms

far N as the Forth and exterminating the Celts or driving them into the mountains of Wales or into remote fastnesses in Cornwall according to others they absorbed their victims without exterminating them. A third theory is that they merely settled on the E. and S. coasts of England and that all the inhabitants of the island—Angles, Saxons, Jutes, Britons, Picts and Scots—became engaged in a senseless welter of indiscriminate warfare. At all events an Anglo-Saxon language began to spread all over England and a

fact which suggests that there must have been a dominant race with a fair measure of homogeneity. Separate groups now began to form themselves into distinct kingdoms. The older historians, presupposing a more sharply distinguished apportionment of the country than perhaps existed, speak of a heptarchy of seven kingdoms, *viz* Kent, Essex, Sussex, Wessex, East Anglia, Mercia, and Northumbria. The expression is misleading, as the number of kingdoms varied from time to time. Northumbria, for example, included Bernicia and Deira. By c. 600 the smaller kingdoms had been absorbed, and only Northumbria, Mercia, Kent, and Wessex retained their individuality.

Meanwhile, the Celts who had escaped extermination or absorption had retired to the W, S W, and N W. In the N W had arisen the British kingdom of Strathclyde, which appears at one time to have extended from Dumbarton to the Dee, and to have maintained a sort of independence down to the 10th cent. In the fog of war which envelops this period we catch glimpses of wars and battles between the Anglo-Saxons and their British neighbours.

The whole of Anglo-Saxon England had by this time relapsed into heathenism. Whether the Christian communities that had formed in the later years of the Roman occupation vanished altogether, or whether a few obscure strands of religious observance remained to link the earlier with the later dispensations, is an unsolved problem. Perhaps St Patrick, who went from Wales (?) to Ireland and was preaching the Gospel early in the 5th cent., represents this link. St David preached in Wales a century later, and St Columba founded his monastery at Iona in 563. By the end of the 6th cent. the process of reconverting England began. In 597 St Augustine led a mission to England, and became the first Archbishop of Canterbury, converting Ethelbert, King of Kent. A church was dedicated at Rochester in 604. By 625

Paulinus had converted Northumbria, his successor, St Aidan of Iona, established himself on Lindisfarne, and reorganised the Northumbrian church. The whole of England was not, however, easily won over to Christianity, the champion of paganism being the warlike Penda, King of Mercia. But the unification of the English Church under Theodore of Tarsus paved the way for the unification of the English State.

In any community, whether of individuals or of nations, the tendency is for one or other of the members to acquire an ascendancy over the rest. It is not, therefore, surprising to learn that from an early date the ruler of one or other of the S English kingdoms was acknowledged as Bretwalda, or overlord, for the time being. In the 7th cent Northumbria, hitherto outside this loose confederacy, became a member, and three Kings of Northumbria obtained recognition as Bretwalda. In the 8th cent the overlordship of the S was assumed by Ethelbald (715-757), King of Mercia, and developed by Offa, who called himself "King of all England". Offa's dominion included Northumbria (then reaching to the Forth), but not Cornwall. Its W limit was marked by the great dyke which bears his name (*see* OFFA'S DYKE). Twenty-five years after Offa's death the suzerainty passed to Egbert, King of Wessex (d. 839), who is usually regarded as the first King of England. Hitherto Wessex had been an unimportant kingdom, but henceforth it was to have much greater significance.

The unification of England came at a critical time, for the Danes now began to harry the E coasts. In 865 they settled as conquerors in Northumbria, E Mercia and East Anglia, in 871 they invaded Wessex. But the King of Wessex and of England was now Alfred the Great (871-900), and he defeated the Danes at Ethandune (Edington) in 878. At the treaty of Wedmore, realising that he was not strong enough to drive the invaders out of the country altogether, he agreed

to divide England between his own Wessex and the Danish tract called the Danelaw (q.v.) the boundary running from a point just E. of London along the line of Watling Street (the present Holyhead Road) its NW point being undefined. Meanwhile Alfred began to build a navy the existence of which would not only induce the Danes to respect the treaty but would discourage further invasion from overseas. An important clause in the treaty was the agreement of the Danish leader to accept Christianity.

After Alfred's death the Danelaw was gradually conquered by Edward the Elder (900-24) who besides being acknowledged in 919 overlord of all England allied himself to the Welsh kings and received the homage of the Kings of Strathclyde and of Scotland. His son Athelstan (924-40) had to cope with the invasion of the Scandinavian King of Dublin Anlaf Guthfrison whom he defeated at Brunanburh in 937. After Athelstan's death Anlaf again invaded England compelling King Edmund (940-46) to acquiesce in a new partition of the country the dividing line again being Watling Street. But after Anlaf's death Edmund reconquered most of his lost territory. King Edgar the Peaceful (957-75) who reigned with the help of the great ecclesiastic Dunstan was acknowledged as overlord by the Celtic princes beyond the border. He was the last of the great Anglo-Saxon kings.

In the reign of Ethelred the Unready (Readeless 978-1016) the Danish invasions began again in greater force than ever before. For a time Ethelred bought peace by means of Danegeld (q.v.) but in 1033 Sweyn (Sweyn) overran England and was recognised as king. Ethelred fled to the Court of his cousin Richard Duke of Normandy but returned to England on the death of Sweyn in 1044. On Ethelred's death two years later England was divided in allegiance between Ethelred's son Edmund Ironside and Cnut of Sweyn. Edmund Iron-

side's early death solved the problem of succession and the Danish line prevailed. Cnut or Canute (1017-35) ruled sternly but well respecting English tradition and upholding English law. The Danish dynasty did not survive the death of Cnut's son Harthacnut in 1041 when the heir of the house of Wessex Edward the Confessor (1041-66) was summoned by the nobles to the English throne. Edward who had lived long in Normandy introduced Norman customs a living of Norman knights and priests and promised the succession to his cousin William Duke of Normandy. He was naturally unpopular. The English opposition was led by Godwine Earl of Wessex and by his son Harold. On the death of Edward in 1066 Harold was elected king by the Witan crowned in London and generally accepted all over the country. But his brother Tostig who had been exiled as a traitor from his earldom of Northumbria called in Harold Hardrada of Norway who invaded England and occupied York. Harold of England hurried N. and defeated his brother and his name sake at Stamford Bridge on Sept. 25, 1066. Three days later William of Normandy landed at Pevensey and Harold was obliged to hasten S. again without preparation and without sufficient forces to meet this new and far more formidable danger.

In addition to obtaining from Edward the Confessor the reversion to the English crown William had some time before tricked Harold while on a visit to Normandy into acknowledging his claim. Further the Pope had excommunicated Harold and authorised William to land in England. On Oct. 14, 1066 Harold and William met at Senlac on the Sussex Downs near Hastings with the result that Harold lost both his crown and his life. On Christmas Day, 1066, William was crowned King of England.

Period from 1066. We now enter upon the second phase of English history. From now on England was generally free from invasion and the

country became consolidated under the new masters. The Normans ("North Men"), who crowded across the Channel in the wake of the Conqueror, were racially much the same as the Angles, Saxons, Danes, Norsemen, and other invaders of the previous 6 cents, but they had lived for 150 years in France, and had there acquired a language and social veneer that antagonised the Saxons. The Saxons overlooked the kinship of the Normans, and resented their foreign ways.

William lost no time in subduing the country. In 5 years he had crushed all opposition. Unlike Cnut, who had taken care to hold the balance between conquerors and conquered, William made a clean sweep, dismissing English priests and officials and replacing them with his Normans. Though he did not introduce feudalism into England, he modified the existing system to suit himself. The danger of the system was the tendency for the local barons to take advantage of any weakness of the central government and grow too rich and powerful for the safety of the Crown. This William met in characteristic fashion when he summoned his vassals to Sarum (Salisbury) and there made them take an oath of allegiance direct to himself. No longer, therefore, could any rebel plead that he was acting under the orders of his immediate lord, since the oath to the Crown overrode all others. By way of preparation for his administrative reorganisation he ordered the compilation of the Domesday Book (q1), which enabled him to determine his requirements in the form of military service and taxation. His aim was to build up a force which should act as a counterpoise to the feudal levies of the barons, and to create a centralised civil service. As far as he was able, he kept the Church in check, refusing to hold England as a fief from the Pope (which John afterwards did), though he conceded the Church courts, whose attempted suppression caused so much trouble between Henry II and

Becket. When William died in 1087 he left behind a homogeneous kingdom, of which he had become the absolute ruler.

The defect of his system was seen in the anarchy rampant in the reign of Stephen (1135-54), in which it was seen that the Norman machine required a strong hand to guide it, and that the safeguards which the Conqueror had imposed over the power of the barons were inadequate.

Henry II (1154-89), the first Plantagenet and a Frenchman, succeeded in restoring order. He re-established the powerful monarchy of the Normans and kept the feudal barons in check, by means of a series of administrative reforms. In 1173 the last great feudal rebellion was suppressed. Henry was less successful in his dealings with the Church. He tried to curtail its power by means of the Constitutions of Clarendon (qv); but the opposition of Becket led to the tragedy at Canterbury and to a long struggle with Rome, lasting to the time of Henry VIII. Ireland also now began for the first time to engage the serious attention of an English King.

The monarchy was strong enough to survive the long absences of Richard (1189-99), but it weathered with difficulty the tyranny of John (1199-1216). John was vicious, tyrannical, and weak—in other words, a typical bully. He was deprived of nearly all his French possessions, he quarrelled with the Pope and was excommunicated; he oppressed priests, barons, and Jews alike, and finally surrendered his crown to the Pope. Having alienated every class of his subjects, he was forced, in 1215, to sign Magna Carta (qv).

John's son, Henry III (1216-72), surrounded himself with foreigners, mismanaged the national finances, and permitted the Holy See to take full advantage of John's unfortunate submission. In 1258, by the Provisions of Oxford (qv), the barons succeeded in driving out Henry's foreign friends,

and in superseding the powers of the Crown by a council of government Henry's attempts to free himself from these new restrictions upon the royal power provoked armed rebellion. Simon de Montfort, who led the rebels, defeated the king at Lewes in 1264 and became for a time virtual dictator of England, though he concealed the extent of his powers by summoning a parliament. He was however himself defeated at Evesham the following year by Edward Prince of Wales who became king Edward I (1272-1307). In 1295, Edward summoned a complete and model parliament which was historically important as an assembly representing all estates. The constitutional history of England is henceforth largely the account of the struggle between the royal prerogative and Parliament. Edward I conquered Wales and Scotland but his son Edward II (1307-27) was routed at Bannockburn in 1314. Edward III (1327-77) laid claim to the throne of France and the Hundred Years War began. The spectacular victories of Sluys (1340), Crécy (1346) and Poitiers (1356) encouraged the English as a nation even if (as is sometimes urged) they were of no real importance. Their immediate effect was the recovery of most of the French possessions that John had surrendered though towards the end of Edward's reign much of the reconquered territory had been lost again. At home the plague known as the Black Death (q.v.) which carried off in 1349 one-quarter of the population had the unexpected effect of improving the position of the working classes by creating a shortage of labour. The result was a demand by free labourers (who were gradually replacing the serfs) for higher wages which was met by a Statute of Labourers. During the reign of Richard II (1377-99) the levying of the Poll Tax excited the Peasant Revolt of 1381 led by Wat Tyler. The rising was suppressed but serfdom was doomed.

Henry IV (1399-1413) was the first

king of the House of Lancaster. His son Henry V (1413-50) followed the lead of Edward III and invaded France but he excelled his predecessor in combining military skill with statesmanship. In 1415 he won the victory of Agincourt. In 1420 the Treaty of Troyes made him the son-in-law of the French king and the heir to the French throne. But as he died before Charles VI of France the union of the two crowns was not accomplished though the empty title King of France remained part of the style of the king of England for several hundred years. Henry VI (1422-63) succeeded at the age of one and the country was at first governed by a Council of Regency. In this reign Joan of Arc relieved Orleans in 1428 and after the battle of Châtillon in 1453 the English lost all their French possessions except Calais. At home after the rising of Jack Cade (q.v.) the Duke of York claimed the throne and the Wars of the Roses (1455-85) ensued. The cause of the Yorkists prospering York's son became Edward IV (1461-83). Edward took swift advantage of the exhaustion of the old nobility in a civil war that had lasted for 28 years to rely on his prerogative and to rule as an absolute monarch surrounded by a new nobility of his own creation. Parliament was either ignored or reduced to the position of a combined recording and financing machine which functioned at the royal will. Richard III (1483-5) after instigating the murder of his young nephews reigned uneasily for 2 years and was killed at Bosworth Field to be succeeded by Henry VII the first of the Tudors. Throughout this century despite disastrous wars abroad and civil war at home the wealth of England was increasing. This was the period of the Merchant Guilds and Craft Guilds and of the great merchant princes.

Henry VII (1485-1509) by his marriage to Elizabeth of York claimed to unite the rival roses though his connection with the House of

Lancaster was not very close. The excuse for civil war then disappeared, though the reign was disturbed by the Yorkist conspiracies of Lambert Simnel (1487) and Perkin Warbeck (executed 1499). Henry VII ruled as a dictator, strengthening his position by means of the Star Chamber, though not using this Court to the extent practised by the Stuarts down to 1641. He betrothed his son Henry, afterwards Henry VIII, to Catherine of Arragon, and married his daughter to James IV of Scotland, little knowing that the first marriage would occasion the Reformation and the second lead, not only to the Stuart dynasty and union with Scotland, but also to the Civil War and constitutional monarchy. Fully occupied with his immediate concerns, Henry VII amassed a large private fortune, which was augmented by his encouragement of shipbuilding.

Meanwhile occurred the wonder of the Renaissance. Progress moved swiftly. The art of printing was introduced by Caxton at Westminster in 1476, 20 years after the publication of Gutenberg's Bible. Fire-arms were replacing more primitive weapons of offence. Columbus sailed to America in 1492. Vasco da Gama doubled the Cape of Good Hope, and discovered the sea route to India in 1497-8. Martin Luther, born in 1483, nailed his 95 Theses on Wittenberg church-door in 1517. In Prussian Poland Copernicus, born in 1473, formulated the theory that the earth went round the sun, with the result that all previously held views of the universe received a rude shock.

Henry VIII (1509-47) carried despotism to a point far beyond that dared by his father. Nevertheless his reign may be regarded as decisive for the ensuing period. He is credited with the foundation of the British Navy, soon to be tested in the great struggle with Spain under Elizabeth. His influence on the Reformation was far-reaching. In the early years of his reign he allowed Cardinal Wolsey, who filled

the offices of Papal Legate and English Foreign Minister, to govern the country in all but name; and for a time Wolsey continued to hold the balance between the rival interests of France and Spain. But Henry was bent on obtaining a divorce from Catherine of Arragon and, finding the Pope obdurate, and Wolsey, who was hampered by his divided allegiance, unable to help him, he dismissed his hitherto trusted adviser. He then skilfully took advantage of the growing restiveness of his subjects under papal domination, and the monarch who had received from the Pope, as recently as 1521, the title of "Defender of the Faith" proceeded in 1529 to cut himself and his country adrift from the influence of the Holy See. He summoned Parliament that year, and at the end of 7 years the breach with Rome was complete.

The next 3 monarchs of England were all children of Henry VIII by different wives. Edward VI (1547-53), son of Jane Seymour, was only 10 years old when he came to the throne, and the country was ruled, first by his uncle, who became Protector Somerset, and then by John Dudley (Northumberland), who had suppressed the peasant rebellion led by Ket in 1549. Meanwhile, the Church, led by Cranmer, who had effected the divorce of Catherine of Arragon in 1533, was tending more and more towards Protestantism. When, however, Mary (1553-8), the daughter of Catherine, and the first woman ruler of England, succeeded, a complete reversal of policy was effected. Not only was Mary a Catholic, but she naturally resented the Protestant archbishop's insult to her mother, and she had further cause for anger when Cranmer supported her half-brother in devising the crown to Lady Jane Grey, the "Nine Days' Queen." But besides enforcing an official return to the Roman fold, Mary, by her marriage to Philip II of Spain, endangered the very independence of England. Involved in war with France as a result of her alliance with Spain,

England lost Calais the last of her French possessions in 1558

Mary's half sister Elizabeth (1558-1603) who was the daughter of Anne Boleyn was faced with the twofold task of restoring the reformed religion and securing her country's independence. Her political shrewdness told her that whatever might have been her private tastes her position (and indeed her safety) depended on her ability to steer a middle course between Roman Catholicism on one hand and the Calvinism of Geneva on the other. Aided by Lord Burghley and other competent advisers she performed her task with great astuteness. While encouraging courtiers she preserved her influence and independence by persistently declining offers of marriage though these were many. Her reign was marred by the execution of Mary Queen of Scots who claimed the throne of England by virtue of her descent from Margaret Tudor and by the persecution of the Catholics which must be regarded partly at least as a reprisal for the treatment of Protestants in the previous reign. The defeat of the Spanish Armada in 1588 by the young English Navy (for the existence of which Elizabeth's father was responsible) not only secured the independence of England but established the country as a great Power. The Elizabethan age was one of exploration and maritime enterprise though until 1583 when Sir Humphrey Gilbert occupied Newfoundland England possessed (for the first time since the Conquest) no territory outside the British Isles. Following expeditions by Sir Walter Raleigh and others a tract of land in N America was named Virginia in honour of Elizabeth though no permanent settlement was made till the beginning of the following century. The East India Company was founded in 1600. A spirit of enterprise and adventure was abroad not only in the field of exploration but in many other directions. The reign gave its name to a period of English literature (q.v.) whose greatest

figure however survived to the time of James I to a style of architecture and to a style of furniture.

The Modern Period On Elizabeth's death the succession passed by strict order of inheritance to a Stuart the son of Mary Queen of Scots James VI of Scotland. Thus the marriage-schemes of Henry VII had at last borne fruit and England and Scotland were united in fact though the Act of Union was not to be passed till the reign of Anne more than 100 years later. The Scottish king and author who became James I of England (1603-25) believed in and wrote a book about the divine right of kings and found himself at once engaged in a constitutional struggle with Parliament which was to end in civil war and the execution of his son. Fortunately for England the continental nations were fully occupied with the Thirty Years War (1618-48). Unlike the Tudors some at least of whom had remained popular whilst retaining what was virtually absolute power the Stuarts were almost universally disliked and their attempts at despotism were pitifully unsuccessful. Apart from a temporary feeling of relief at the Restoration it was not till the days of the Old and Young Pretenders that the glamour which informs a lost cause produced a sentimental reaction in their favour. James's more stubborn son went farther and fared worse. Charles I (1625-49) was forced in 1628 to accept the Petition of Right (q.v.). From 1629 to 1640 he ruled without a Parliament raising money by means of the device known as Ship Money (q.v.). In time however this source of income proved inadequate and Charles was obliged to seek Parliamentary aid. At the Long Parliament (summoned 1640) he was presented with the Grand Remonstrance (q.v.). He attempted to introduce episcopacy into Scotland. Finally he plunged the country into civil war when after a futile attempt to seize 5 members of the House of Commons he left London. (For the events of the Civil War see WAR THE CIVIL.)

In 1649 Charles was executed and England became a republic, the period to the Restoration being generally known as the Commonwealth. The execution of the King led to Royalist rebellions in Ireland and Scotland, crushed respectively at Drogheda in 1649 and at Worcester in 1651, in both cases by the genius of Oliver Cromwell (*q.v.*), the Parliamentary general who now virtually ruled England. Cromwell, made Protector in 1653, attempted to reorganise the shattered constitution. But he was unpopular with the more extreme Puritans, and detested by the conservative element. A nation that had executed its king for attempted despotism was not likely to favour, though it might endure, a military tyrant who had not even the excuse of royal birth. In Ireland especially his acts produced a sense of grievance so keen that his memory is still execrated there. Abroad, however, he raised the prestige of his own country as the champion of Protestantism.

The weakness of dictatorship being its personal aspect, it is not surprising that the system survived only 2 years after the death of the masterful autocrat. In 1660 the second son of Charles I was manoeuvred on to the throne of England by Monk. The country turned with a sigh of relief to Charles II (1660-85), and the Restoration was at first very popular. But it was not long before the disillusioned people, tired of the caprices of the merry monarch, began to remember with tolerant regret the gloomy tyranny of the Puritan Dictator. Nell Gwynn is but a poor substitute for Dunkirk. Charles, who was always in need of money, sold himself to the King of France, and became involved in a disastrous war with Holland, during which the Dutch fleet ruled up the Meuse. Attempting to secure religious toleration, Charles alienated Parliament, and the opposition did not hesitate to make use of the Popish Plot invented by John Oates (1678). But the reign of Charles was not uniformly bad for the ordinary citizen,

for example, the Habeas Corpus Act was passed in 1679, and party government, perhaps the simplest and most workable method yet devised of conducting the country's business, was beginning. The Whigs and Tories, who now appear, were the political descendants of the Roundheads and Cavaliers. At home two domestic tragedies stirred the nation—the Plague in 1665 and the Great Fire of London in 1666. The Rye House Plot to assassinate the King and to replace him on the throne by the Duke of Monmouth was discovered in 1683, and Charles died a natural death.

His brother James II (1685-8) was likewise a submissive pensioner of Louis XIV. By his obstinate and tactless behaviour at home he succeeded in alienating every class in England. Bent on making himself absolute monarch and on restoring the Roman Catholic religion, he established a standing army at Hounslow to overawe the capital, and he granted civil and military commissions to officers of his own faith. In 1685 he punished the rebellion of Monmouth with ruthless severity, in 1687 he published the Declaration of Indulgence (*q.v.*) and arrested 7 bishops for petitioning against that egregious document. The birth of a son on the day of their arrest precipitated a crisis. Sooner than run the risk of the infant growing into a tyrant-king, Englishmen united in extending an invitation to William III of Orange, who had married James's Protestant daughter Mary. On Nov. 5, 1688, William landed at Torbay. James fled to France. Absolutism was over and constitutional monarchy was established. Henceforth despite the attempt by George III to gain unconstitutional power, the monarch loses its supreme importance, and the fortunes of the country are no longer dependent on the caprice of its king. William and Mary reigned as joint monarchs until the death of Mary in 1694, after which the Dutch prince reigned alone. On Feb. 13, 1694,

they accepted the Bill of Rights (qv) which was to safeguard the country against all further attempts at absolutism. The revolution had been bloodless in England though in Scotland and Ireland there were abortive risings the massacre of Glencoe occurring in 1692. By the Treaty of Ryswick (1697) Louis XIV agreed (*inter alia*) to abandon the cause of James II and to acknowledge William of Orange as rightful King of England but when the exiled James died in 1701 he pressed the claim of the Old Pretender as James III. The beginning of the reign of Anne (1702-14) was disturbed by the War of the Spanish Succession in which the great victories of Marlborough reduced the military power of France. The Treaty of Utrecht (1713) ending that war not only confirmed France's acknowledgment of the Protestant succession in England but promoted the development of the British colonial empire by giving England Newfoundland Nova Scotia the Hudson Bay territory some of the W Indies Gibraltar and Minorca. England emerged from the war at the head of the great powers. In 1707 the *de facto* union of England and Scotland was recognised by the Act of Union.

Queen Anne a 15 children all pre-deceasing her the provisions of the Act of Settlement (1701) gave the throne of Great Britain and Ireland to the Elector of Hanover who was descended from a daughter of James I. There was now to be a succession of four Georges from 1714 to 1830. George I (1714-27) who knew no English was doubtless thankful that the new constitution enabled him to be a figurehead while his ministers ran the country. Party Government was by now in full working order though for 50 years the Tories remained in opposition. From 1721 to 1742 the country was ruled by that great Whig statesman Sir Robert Walpole. Of the two Jacobite (qv) risings occurring in the period the first (1715) excited very little interest the second (1745) in the reign of George II (1727-60) was

more serious not being finally quelled till Culloden in April 1746 in the middle of the War of the Austrian Succession. The Seven Years War (1756-63) brought out the financial dexterity of William Pitt the elder and while it made Prussia into a first-class Power it carried the development of England's colonial empire a stage farther. France lost Canada and the British successes in India laid the foundations of the Indian Empire. George III (1760-1820) who came to the throne before the end of the Seven Years War made at the beginning of his reign a determined effort to recapture much of the Royal power that had been lost in the Revolution of 1688 and for a time achieved a kind of personal government. The loss of the American colonies however following the Declaration of Independence in 1776 and the recurring fits of insanity in the King put an end to this attempt on the constitution. The outbreak of the French Revolution in 1789 led to a series of wars which lasted for 20 years during which the genius of Napoleon found full scope and England guided by the younger Pitt fought for her very existence (*see* FRENCH REVOLUTIONARY WARS). The naval victory at Trafalgar (1805) was the decisive battle of these wars though Napoleon continued the struggle for another 10 years to be finally vanquished at Waterloo (1815). England emerged triumphant having in the words of Pitt saved herself by her efforts and Europe by her example.

Almost coincident with the French Revolution and its incalculable consequences was the Industrial Revolution (qv) which turned England from an agricultural into an industrial country. It may be regarded as originally an English Revolution since most of the inventions which made it possible were British. The European depression following the Peace of Paris (1815) and the temporary dislocation of society following the application of these new inventions ushered in a period of great distress and unemployment.

ment Riots occurred in Manchester (1810), Glasgow (1820), and elsewhere. The spirit of reform was in the air, but the Ministry, regarding any kind of reform as leading to the worst excesses of revolution, remained obdurate. The old system of party representation was out of date and anomalous. Great manufacturing centres such as Birmingham and Manchester were unrepresented, while places like Old Sarum (with two inhabitants) and Dunwich (under the sea) returned two members each. The system was further vitiated by the existence of "pocket boroughs". The reformers, inspired by the July Revolution in France (1830), introduced three reform bills in 1831, and the following year Parliament reluctantly passed the Great Reform Bill. This by no means gave the universal suffrage that is a commonplace to-day, but it was the first serious step in that direction. Meanwhile, George IV (1820-30), who had acted as Prince Regent during his father's insanity, had been replaced by the eccentric William IV (1830-37).

The reign of Victoria (1837-1901) covered a period of momentous change. The Industrial Revolution made England the workshop of the world. The development of the steam engine was to revolutionise industry, as well as transport by land and sea, though by the end of the century steam itself was beginning to be threatened by electricity and oil. The new conditions brought new problems in their train. The first Factory Act was passed in 1837, and trade unions were recognised, after years of strife, 30 years later. The Corn Laws were repealed in 1846 and an era of free trade began. The country steadily grew richer, and was only indirectly affected by the revolutionary disturbances in 1848, being more concerned with the religious controversies over the Tractarians, and then the restoration of the Roman Catholic hierarchy in Great Britain, than with questions of governmental forms.

Mistress of the seas since Trafalgar, she held aloof except where the safety of her growing Empire was threatened. Thus she supported Turkey against Russia in 1854, partly to maintain the Balance of Power, and partly to diminish the dangers of a Russian attack on India. In India she dealt firmly with the mutiny in 1857, eventually turning the outbreak to account when Disraeli made the Queen Empress of India (1876). The opportunism of Disraeli gave Great Britain a controlling interest in the Suez Canal Company (1875). Numerous wars in Egypt, the Sudan, Africa, on the Indian frontiers, etc., were directly concerned with the consolidation of the colonial empire. At the end of the century the Transvaal and Orange Free State were annexed after the second Boer War (*qv*), later to become part of the Union of S. Africa, thus continuing the list of self-governing dominions initiated in 1867 with the Dominion of Canada (*see* BRITISH EMPIRE).

The reign of Edward VII (1901-10) was a period of ententes, alliances, and counter-alliances, concluded either as defensive measures or in the hope of preventing war. Socially it marked the end of an epoch. The most important inventions were perhaps the various applications of wireless telegraphy and telephony, pointing the way to broadcasting, and the aeroplane, which developed with such remarkable rapidity in the World War. The motor-car became established and universal. The first part of the reign of George V (*acc* 1910) was taken up with labour troubles, constitutional disputes, Home Rule, and a serious threat of war in 1911. The powers of the House of Lords were restricted in 1911. On Aug. 4, 1914, Great Britain entered the World War (*qv*). In April 1916 occurred the Irish rising, on Nov. 11, 1918, the Armistice, signalling the end of the World War, was signed, and on June 28, 1919, the Treaty of Versailles, followed by other peace treaties. The Irish Treaty of

1911 led to the establishment in 1920 of the Irish Free State. The first Labour Government took office in 1914. Acute post-war depression and unemployment on an unprecedented scale became world-wide. Reparations war debts security were the unsolved or partly solved problems of the age which has witnessed Bolshevik rule in Russia Fascism in Italy and Germany dictatorships successful and unsuccessful in Spain Greece Poland and elsewhere and a prolonged economic crisis of the first magnitude. On June 1st 1933 the World Economic Conference assembled in London with the express object of finding some way out of the universal economic difficulties. It came to no effective conclusions.

English Language. This is the language spoken throughout the British Isles the British Empire and the U.S.A. In its present form it is the result of a fusion with other languages which is unique in the history of linguistics but it remains fundamentally what it was originally namely a member of the Low German branch of the Teutonic or Germanic group of Indo-European Languages (q.v.) which was brought to Great Britain by the Angles and Saxons and Jutes who invaded and conquered the island in the 5th and following centuries. It is closely allied to Dutch Flemish and Frisian and more remotely to German and to the Scandinavian languages. Historically it may with some accuracy be divided into three periods: (1) Anglo-Saxon or Old English up to c. 1150; (2) Middle English c. 1150-c. 1450; and (3) Modern English. The following three English versions of Mark iv 39-40 will give some idea of the differences of the language of these three periods.

Anglo-Saxon (late). And he aras and tham winde behead and cwæth to there se Suwa and gestille. And se wind geswac tha and wearþ mycel smyltnes. And he sæde him Hwæt synt ge forhte? gyt nabbaþ ge geleafan?

Middle English (Wyclif 1380). And he rysynge up : anasside to the wynd and seide to the see He stille wexe dounþ And the wynd ceaside and greet feiblenesse is maad And be seith to hem What dreden yee?— Nat yit han yee feith?

Modern English (Authorised Version). And he arose and rebuked the wind and said unto the sea Peace be still And the wind ceased and there was a great calm And he said unto them Why are ye so fearful? how is it that ye have no faith?

It will be seen that the proportion of non-Teutonic words (indicated by italics) is very small even in the third extract (which however is hardly representative in this respect). Incidentally these three passages illustrate another feature of the language namely its increasing love of monosyllables the proportion of which in the first second and third passages is respectively 63.8 79.5 and 90.7 per cent.

A few observations on the grammatical structure of the Anglo-Saxon extract will indicate one of the greatest changes that the language has undergone that is the loss of inflexions *aras* past tense of *arisan* to arise *tham* dative singular from *se* the masculine in agreement with *winde* dative of *wind* *behead* past tense of *be heodan* to bid command which governs the dative case *cwæth* past tense of *cwæthan* to say (cf. *quoth*) *there* dative singular from *seo* the feminine in agreement with *se* which is dative governed by the prepositon *to* *suwa* and *gestille* imperative singular from *swesan* to be silent (cf. German *schweigen*) and *ge stilla* to be still respectively *se wind* the wind nominative masculine *gewac* past tense of *geswican* to cease *tha* then (cf. German *da*) *acariþ* past tense of *weorþan* to become (cf. German *werden* and English *woe worth the day*) *smyll* es noun formed from adjective *smolt* mild

him "to them", dative plural from *he*, governed by *sæde* "said", (the modern accusative singular "him" was *hine* in Old English, and this survives in the provincial "I see 'un") *synt*, present tense plural of verb "to be" (cf Ger *sind*, Lat *sunt*) *ge* "ye", (modern "you" derives from old accusative *eow*) *forhte*, strong plural of adjective *fohrt* "afraid", (cf strong and weak declensions of the German adjective) *gyt* "yet, still" *nabbath*, present tense plural (negative form) from *habban* "to have" *geleafan*, accusative of *ge-leafa*, "believe, faith"

It is apparent from the above that English was originally a very highly inflected language that is to say, its nouns, adjectives, and pronouns had several cases and a singular and plural number, and were, in short, "declined" very much in the manner familiar to the schoolboy learning Latin or Greek, and that its verbs, similarly, were "conjugated". Some of these inflexions remain in modern English. We still have "strong" verbs (e.g. *drink*, *drank*, *drunk*) and "weak" verbs (e.g. *praise*, *praised*, *praised*), and we still distinguish the 3rd person of the present singular, *drinks*, from the other persons, *drink*. Of the varied and complicated noun declensions, we have now only the plural in *-s* and a few "irregular" plurals like *feet* and *oxen*, and the possessive cases in *-'s* and *-s'*. Our adjectives have one invariable form instead of a maximum of eleven forms in Anglo-Saxon. It is only the personal pronouns which, for purposes of syntactical clarity, have to a large extent retained their inflexions.

A few isolated survivals of the old inflexions are of interest. The modern adverb *whilom* is historically the dative plural, *hwilum*, of the noun *hwil*, and means "at whiles". The intensive prefix *ge-*, which, among other uses, was generally in Old English (as it is still in German) prefixed to the past participle of verbs, has left one faint trace in the word "handwork".

One other fact which emerges from an examination of the above passage of Anglo-Saxon is that the old language had three genders, masculine, feminine, and neuter. These genders were entirely dependent upon the grammatical form of a noun, and had no relation to its sex or lack of sex, and modern English is unique among the Indo-European languages in having discarded this meaningless grammatical gender in favour of a natural gender dependent upon sex, indeed, in no other important language, except perhaps Chinese, is gender so simply determined as it is in English.

The question, then, arises: How, when, and why did this inflexional levelling and loss, this simplification of the language, take place? There can be no doubt that the process had begun long before English was the language of England, and even before it was a separate language at all, but that is a fact which lies outside the field of this article. The answer to the question 'When?' is that it was a gradual process, and that it would be rash to assert that it is even now completed. The questions 'How' and 'Why' may be answered together. It was to some degree due to the natural decay of so vital a thing as a human speech, and to its speakers' growing intolerance of complicated grammatical distinctions, but, far more than this, it was due to the peculiar circumstances of English history, which brought the language into direct contact with, and thus under the influence of, other languages. Even in its earliest form, English was not one standard language: it was at least four distinct dialects: Northumbrian, Mercian or Midland, Wessex or Southern and Kentish. It is an invariable and perfectly understandable tendency of all dialects (as such) to coalesce into one standard speech, and the process of such coalescence must involve the sacrifice of those linguistic elements in each dialect which are most foreign to the other dialects, or, alternatively, the absorp-

hundred years or so that remained of the Old English period after the Conquest, the French that influenced the language was the N dialect of Normandy and Picardy. This differed from Parisian French in several ways, for example, where Norman French had a *k* sound Parisian had a *ch* sound. Thus the English *catch* was an earlier borrowing than *chase*, although the ultimate etymology of the two words is identical. Thus the influx of French words into our vocabulary had a two-fold source. Up to c 1150 (the close of the Old English period) it was the N French which provided that source, and it cannot be said that during this period English and French formed a really happy blend. As a matter of practical necessity, a great number of French words were adopted into English speech, but English still retained most of its old characteristics. The process of grammatical simplification went on at a fairly normal rate, but there was no rapid and fundamental change in the character of the language. It was not until the coming of the Angevin dynasty and, with them, of the French of Paris, that English began that process of harmonious blending with French which marked the Middle English period, that is the period of c 3 cents following the middle of the 12th cent.

The influence of French during this period was enormous. Not only did extensive word borrowing continue in both spoken and literary English, but the process of breaking down the old grammatical complications was tremendously accelerated, for English did far more than borrow words from French. For a variety of reasons which need not here be considered, English was, at this period, ripe for the absorption of much of the linguistic character and structure of French, our language digested and assimilated the French influence, and in so doing profoundly altered its own morphology, yet, in a manner unique in all linguistic history, throughout and after this stupendous process of change it re-

mained English all the time. It has never been *French-English* or *English-French*. There has been no other example of such perfect fusion between two such remotely connected languages as Teutonic English and Romance French.

Apart from the French influence, the history of Middle English is largely that of its three main dialects, N, Midland, and S, and of the ultimate ascendancy of the second of these. The N and S dialects were considerably different from each other; the Midland had points in common with each and, if only for this reason, was more likely to become the standard speech than either of its rivals. In addition to this, Midland was the dialect of the capital, London, and furthermore, it was that of one of the great "makers" of English, Chaucer. Yet the dialects died hard. N., in the form of Lowland Scottish, still lives as both a spoken and a literary dialect. S has not so successfully preserved its independence (though it had an attempted revival in the poems of William Barnes), but it was not until comparatively recent times that the S third person singular in *-eth* (which still survives as a perfectly familiar archaism) finally gave way to the Midland and N *-s*. However, it is enough to say that Midland did in fact become the standard dialect, and therefore only this dialect need here be considered in remarking upon the characteristics of Middle English.

Anyone who takes the small amount of trouble that is required to understand, and consequently to enjoy Chaucer, cannot fail to notice the differences between his English and that of our own day, but if he should also so considerably trouble himself as to understand Anglo-Saxon, he would notice that the difference between this and Chaucer is far greater than that between Chaucer and Modern English. For it was during the Middle English period that the process of analysing out the old inflexional system reached such a pitch as to make the writer

language recognisable as English even if not entirely understandable to the most modern of present-day readers. Such a reader will of course find in Chaucer many words which will send him straight to the glossary for their interpretation. Such words will either be relics of the old Anglo-Saxon vocabulary or borrowings from French which have not survived, or they may be surviving words in an unrecognisable form. But even more forcibly will such a reader be struck by the apparent peculiarity of Chaucer's spelling and by certain unfamiliar grammatical forms and constructions, and it is with these last two aspects of Middle English rather than with its actual vocabulary that this brief survey is concerned.

The rejection of all the old grammatical cases of nouns except the nominative plural and the possessives and the simplification of verb conjugations have been referred to at the beginning of this article. Here it need only be added that this was a development of the Middle English period as was also the truly remarkable substitution of natural for grammatical gender. These changes in the aggregate brought the language so far from its original form and so close to its modern form that it is all the more disconcerting for readers of Middle English to find some difficulty over the sheer grammar even after they have familiarised themselves with the vocabulary and spelling. Yet it would be far more surprising if this were otherwise for though the changes in the language were at certain periods very rapid they were nevertheless the outcome of gradual development. They were not suddenly enforced by royal edict or Act of Parliament. Therefore much of the spirit and syntax of the old grammatical system lingered on even after the actual grammatical forms by which they were originally distinguished had disappeared, and it was only gradually that a new and analytical syntax was evolved to give clarity to the new grammatical nature of the language.

It must be remembered that in reading any Middle English text we are looking at the written language, not listening to the spoken language. Many who may be able to read Chaucer with ease would be sadly at sea if it were possible for them to hear a gramophone record of Chaucer reciting the *Canterbury Tales* and among many inference which may be drawn from this fact it is possible that the spoken language is even more grammatically simple and inflexions which are not immediately apparent to the reader of a printed text. The untrained reader might for example on finding the word *sucte* in Chaucer do no more than recognise it as the modern *sweet* and pronounce it accordingly. Yet Chaucer's *sucte* was a word of two syllables and was pronounced something like *suivtu*. Not only were the final -es of Middle English words usually pronounced as separate syllables but also the *v* sometimes were a survival of the older grammatical inflexions. It follows then that Middle English is not always quite so easy as it looks, and to account for this it is necessary to consider briefly the relations between the pronunciation and the spelling of English.

It has been said that Chaucer's spelling looks peculiar to the modern reader, but as a matter of fact it is nothing like so peculiar as modern English spelling. It is substantially true to say that up to the beginning of the Modern English period English was spelt as it was pronounced, that is to say that our spelling was as far as the limitations of our alphabet would permit phonetic. The pronunciation of English like that of every other language has always been and still is changing, and up to a certain point the spelling quite logically changed with it. Anglo-Saxon *stān* was pronounced STAIN in Middle English the pronunciation had changed to STAWN and it was consequently spelt *stow* (in which the long *o* had its pure sound without a trace of a diphthong) in Modern English this sound

has become diphthongised with *u* to give the present pronunciation of *stone*, but the vowel *o* has remained in the spelling as in Middle English (the final *e* being silent, a mere modern addition to indicate to the eye that the preceding *o* is long and not short, and that the word rhymes with *bone* and not with *don*). But with the advent of the printing press, and the consequent great increase in the number of books, it very soon became the tendency to standardise the spelling and to fix it in one form, and the result of this is that our modern spelling, so far as it represents anything at all, represents the language as it was pronounced in the 16th century, and represents even that very badly owing to the misguided attempts of various insufficiently informed philologists to give it a measure of etymological correctness. Meanwhile, the pronunciation has continued to change, so that there is now almost no relation except that of memory and habit between the spoken and the written language. It follows from this that Middle English really differs from Modern English far more widely than it appears to do from a casual glance at a printed page of Chaucer. In fact, one of the few advantages of our obsolete and incongruous modern orthography is that it familiarises us with something approaching the appearance of the language as it was written many centuries ago, and makes "old-fashioned" English look less old-fashioned than it is.

To return for a moment to grammatical developments, it was during the Middle English period that the language evolved its present verbal system, which is more complete, more capable of expressing subtle shades of meaning than that of any other language. Anglo-Saxon had one present tense, and one past tense, we have now at least three forms of each, each with a slightly different meaning. We are not now limited to *he drinks* or *he drank*, we can say *he does drink*, *is drinking*, *did drink*, *was drinking*. (This at once opens the question of the

participle in *-ing*. Anglo-Saxon had a verbal noun in *-ung* [*-ing*] and a present participle in *-ende*, but the latter of these has taken the form of the former so that they are now identical in sound and appearance. But in the expression *he is drinking* we have, not the participle, but the noun, as may be seen from the provincialism *he's a-drinking*, which is merely a corruption of *he is on drinking*.) English, like other Germanic languages, never has had a true future tense, but it has supplied the deficiency (less happily than has German with *werden*) by the use of the two auxiliaries *shall* and *will*, the former of which really means *must*, and the latter *intend*. The average educated Englishman knows by instinct which of these two auxiliaries should be used in particular cases, but it is a matter of very great difficulty for the foreign student of English, and also for certain provincial and Celtic speakers of English. A Scotsman, for example, will say, "Will I get you your tea?" Grammarians have attempted to formulate rules for the correct use of these verbs on the basis of the person of the speaker and of emphasis or non-emphasis, and such rules are in the main reliable; but we all know that we are constantly breaking them, and that we are speaking perfectly correct English when doing so. It is, as has been said, a matter of that instinctive knowledge of the language which only a native can ever completely acquire. The same is true of *should* and *would*. Returning to the past tense, we have, besides the forms already mentioned, those made up of the auxiliary *to have* with the past participle (or with *to be* and the verbal noun in *-ing*), which give us *he has drunk*, *he has been drinking*, *he had drunk*, *he had been drinking* (to which the Irishman might add yet another, *he did be drinking*). Of the remaining verbal forms, the infinitive and the imperative have lost their distinctive grammatical inflexions, but their functions remain perfectly clear and distinct in our modern syntax. It is only in the subjunctive that the modern verb

has suffered loss rather than gain in comparison with that of the original language. It remains in many conditional clauses (*if I were to* is still more correct than *if I was to*) but apart from this it is almost entirely absent in the modern spoken language. In literary English we may still find such sentence as *I shall wait here till he come* but even this strikes the average reader as archaic and pedantic.

Such changes as these and others which there is no space to mention here began to develop some in the Middle English period and some not until the Modern English period. They may be taken as indicative of the way in which the language gradually evolved its present analytical structure while preserving an unshakable foundation of its old inflexional character. This process will never be complete so long as English is a living language and it has been in progress all through what is known as the Modern English period.

It is necessary now to return to the subject of foreign influences. It has been shown that Danish and French besides giving us many new words had a profound effect upon the grammar and structure of our language and this is to some extent true of another foreign language American. But before American existed there were other languages which did not so much affect the structure of English as add to its vocabulary. Italian has given us many terms connected with art and music; we have borrowed words from Spanish Portuguese Dutch German Russian Turkish the Indian languages Malay Chinese Japanese and Polynesian but our combined debt to all these is insignificant in comparison with what we owe to Latin and to a less degree Greek.

There were a few Latin words even in the Anglo-Saxon vocabulary *as set* for example belonged to the language before the English came to England. Later the spread of Christianity

through Roman missionaries necessarily brought us many ecclesiastical Latin words. French itself which has been shown to have been one of the greatest influences in our linguistic history is nothing but a local development of Latin. But apart from all such considerations the revival of learning in England after the Renaissance and our closer acquaintance with classical literature led to a vast amount of borrowing from Latin. Some of this borrowing was direct and other words were taken over in their French form and this fact accounts to some extent for the richness of our vocabulary. For there are many instances in which the same Latin word has been borrowed twice once directly and once indirectly through French but carrying a slightly different shade of meaning in each case. Thus we have such pairs as (putting the direct borrowing first) *legal* and *loyal*, *fidelity* and *fealty*, *capture* and *cassidy*, *gentle* and *jaunty* and a host of others. Latin was up to comparatively recent times acknowledged as the language of scholarship and learning and so it came about that at certain periods many of our writers tended to despise the native vocabulary even when writing English and to use as many anglicised Latin words as possible. This practice was taken to absurd lengths and much of the pomposity of Dr Johnson's work for example is due to the heavily Latin character of his vocabulary but a very great proportion of such words has become a permanent possession of the language which is the richer for having very often both a native and a Latin word for the same concept. In such cases it is usually the native word which is the more forceful and graphic and the Latin word which is useful when too great vividness would be a little out of place or when an unemotional dignity of restraint in language is required. Compare *terminological* *interact* *tude* with *he or he had not the means to provide himself with sufficient nutriment* and in consequence he expired.

with *he hadn't enough money to buy food, and so he starved*

Many Latin loan-words, especially early ones due to Christian influence (such as *church, bishop, priest, deacon*), while they were actually borrowed from Latin are ultimately Greek; and it is in this manner that we have adopted many Greek words. But we have also borrowed directly from Greek, especially for our scientific terminology. *Monarch, democracy*, such words as *telescope, photograph, geology, astronomy*, all are from the Greek or formed from Greek words. New formations of this sort are constantly being introduced as fresh need arises, though some, such as *television*, are not so happy, being a hybrid combination of Greek and Latin elements.

This necessarily superficial survey of the changes, development, and growth of our language would not be complete without a reference to the actual present and the possible future of the language. It is impossible to consider either of these without considering also the American language, for American English has influenced, is influencing, and probably will continue to influence the mother tongue to a very great extent. American has diverged considerably from English, and in respect of such divergences it is a younger and more vigorous speech than English. But here again, English has manifested its old propensity for calmly adopting from another language whatever has appeared to be to its own advantage. There are scores of expressions which now pass unchallenged for the King's English, which would, a generation or so ago, have been scouted as flagrant Americanisms. And now, with so many of the "Talkies" coming from America, this tendency has received an additional stimulus. We may shudder to hear children in the streets saying *Oh yeah* and *O.K.*, *Chief*, but it may well be that our shuddering will not prevent these or other such expressions from becoming part of the standard speech.

Fortunately our language still retains sufficient conservatism and dislike of rapid change to protect itself against these undesirable alien immigrations of speech.

Finally, wireless broadcasting, whether for good or for evil, threatens to have a standardising effect upon our pronunciation, and to hasten the lingering death of the individuality and beauty that are still to be found in some of our provincial and dialectic speech.

For a detailed study of English, the reader may profitably consult Prof. Jespersen's *Growth and Structure of the English Language* (Teubner). The subject acquires an interest unsuspected by the layman in Henry Bradley's *The Making of English* (Macmillan), and in Ernest Weekley's *Romance of Words* (Murray).

English Literature Owing to the changes which have occurred in the language during the 13 or 14 cents of English literary output, it follows that much of our literature is intelligible only to those who have learned to read the language in its older forms. It will, therefore, be convenient to deal separately with that part of our literature which presents to the general reader a more or less "foreign" appearance, and, since a rough boundary must be set, the year 1500 may be taken as an arbitrary dividing-line between the Old and the Modern.

EARLY (up to c 1500)

During the whole of this period poetry is vastly preponderant. Some traditional poems were brought to England by the English from their former continental home, and these are, of course, pre-Christian in origin. Such is the fine epic *Beowulf*. But Christianity is the source from which the first native English poetry flowed, and it sprang up first in the N during the supremacy of Northumbria, where the earliest outstanding names were Caedmon and Cynewulf, and the greatest poetic achievement was perhaps *The Dream of the Rood*, ascribed to

ynnewulf. With the political ascendancy of Wessex the centre of literature moved to the S and W and here again religion was the main motive force. In King Alfred's translations of Latin religious works in the homilies of Ælfric and the Anglo-Saxon Chronicle we have the first beginnings of English prose but such poems as *The Wanderer* and *The Seafarer*, *The Battle of Brunanburh* and *The Battle of Maldon* stand out pre-eminently in the considerable if all too scanty body of pre-Conquest Anglo-Saxon literature that has survived.

After the Norman Conquest English literature enters a chaotic period during which it struggled for existence against the Norman French language until it finally absorbed this influence and emerged triumphantly English. We have a mass of metrical chronicles and sermons in verse such as Layamon's *Brut* and the *Cursor Mundi* and of metrical Romances of French origin including much of the Arthurian legend but there are also many purely native Romances notably *Howeloh the Dane*, *King Horn* and *Guy of Warwick*. *The Owl and the Nightingale* is important as being at least partly lyrical in character and there also survive a number of short lyrics such as *Sumer is i-cumen in* which cannot be omitted from any representative anthology of English poetry. Prose remains almost negligible being practically confined in purpose to the religious and moral instruction of the laity.

About the latter half of the 14th cent. saw the evolution of order out of the preceding chaos. Langland's *Piers Plowman* (136) may be regarded as the last great English work in which the French influence is definitely combated and it is greatly to be regretted that for this reason its vigorous verse and trenchant satire are far less intelligible to the modern reader than is the practically contemporary work of Chaucer (c. 1340-1400). Chaucer a true predecessor in the successful absorption of the French in

fluence was John Gower (c. 1225-1408) whose *Confessio Amantis* shows high poetical technique with very little artistry or genius. The importance of Chaucer cannot be over-stated. Not only was he a genius of the first order but he possessed in the highest degree the national gift for adopting and adapting foreign elements and of producing a result more supremely English than can be the outcome of any strictly insular attitude of mind. It may be permissible to say that it requires surprisingly little effort to read and understand Chaucer and that such effort is well worth making. In the matter of pure form it is to Chaucer that we owe the moulding and perfecting of the decasyllabic or ten-syllable line which is perhaps the commonest measure of English verse. Chaucer was too rare and outstanding a spirit to be the father of a successful literary school and his immediate English imitators Lydgate and Hoccleve and Hawes were quite incapable of grasping his essential human qualities and their work was mediocre at the best. But in Scotland his influence bore more worthy fruit in the work of Henryson (c. 145-1506 *Robin and Maryne*), Dunbar (c. 1460-1520 *The Dance of the Seven Deadly Sins*) and Gavin Douglas (c. 1474-1552 *Translations of Vergil's Aeneid*). Returning again to the S. mention must be made of at least two anonymous poems *Gawayne and the Green Knight* (c. 1350) and *Pearl* (c. 1375) the latter of which rediscovered only in the 19th cent. is unique in its period for its high aspiration and mystical beauty. To the 15th cent. also may be assigned many of the finest of our old Ballads. The last noteworthy poet before the dawn of the modern period was John Skelton (1460-1500).

Prose during this period remains comparatively insignificant and quite unformed. Exception might be made of Chaucer's prose work of the *Travels of Sir John Mandeville* and certainly of Malory's *Morte d'Arthur*. This last is in a class by itself as the greatest

literary work in English of the 15th cent., to which, however, belongs also Wyclif's translation of the Bible.

POETRY (since c 1500)

English poetry was reborn after the Renaissance in the work of Surrey (d 1547) and Wyatt (d 1542), to whom we owe the introduction of the Sonnet form and of Blank Verse, but it did not really begin to grow till we come to Spenser (1552-1599) and Sir Philip Sidney's *Astrophel and Stella* (c 1580). Spenser is regarded as the second great milestone after Chaucer on the road of English poetry. Within the allegorical frame of *The Faerie Queene* is enshrined the expression of the political and moral aspirations of the age.

The Elizabethan Age produced such a wealth of poets that it would be both invidious and difficult to single out particular names. The lyrical spirit of the age is conveniently crystallised in such Miscellanies and collections as *A Handful of Pleasant Delights* (1584) and *England's Ihecon* (1600). Practically all the poetry of the period was the direct outcome of a genuine and justified urge to write. It must not be forgotten that many of the great dramatists (e.g. Marlowe, Jonson, Shakespeare) were also poets pure and simple. The stream of poetry flowed, with a gradually changing course, well into the 17th cent. Herrick (1591-1634), as a lyrical epigrammatist, care-free and pagan, retains for ever his charm. Donne (1573-1631), with his minute analysis of human emotion, is considered one of the great English poets. He was the father of the "Metaphysical" school of poets, characterised by their fanciful wit and violent, far-fetched allusions and comparisons, and including Herbert, Crashaw, and Traherne. Apart from these, and before approaching the subject of Milton, reference is due to the high lyrical qualities of Carew and Marvell.

The formal and spiritual majesty of *Paradise Lost* (1667) sets it inevitably in the forefront of Milton's work, but it

would be a great mistake to suppose that it is representative of all his best work. Many of his earlier and shorter poems, such as the *Nativity Ode*, *L'Allegro*, and *Il Penseroso*, may be said to maintain an even higher level of pure poetry.

The general reaction from puritanism which characterised the Restoration period is reflected also in its verse, but the purely poetic quality does not necessarily suffer for this reason. The one instance of John Wilmot, Earl of Rochester, may perhaps suffice.

The heroic couplet, though not invented by Dryden, is associated with his name because of his mastery of it. For a considerable period this remained the chief medium of poetry, and pure lyricism suffered an almost complete neglect, although a happy exception may be made in the case of Matthew Prior (1664-1721). Dryden's poetic strength lay in the realm of satire and political and religious controversy.

Alexander Pope (1688-1744) was the poet *par excellence* of the so-called "Augustan" age. In his hands poetry became a thing, not of imagination, but of concise and polished wit, classical precision, neatly trimmed epigram. The rhymed decasyllabic or heroic couplet was obviously the most suitable medium for this, and Pope perfected and smoothed it till it became susceptible to almost mechanical imitation by less capable poets. Later in the century Samuel Johnson and even Oliver Goldsmith were largely content to keep to the model of Pope. Yet even in this severely rational and classical age there appeared the seeds of the revival of imaginative poetry. Evidence of this is to be found notably in the lyrics of William Collins (1721-1759) and in the publication of Percy's *Reliques of Ancient English Poetry* (1765), while in Thomas Gray (1716-1771) we have a remarkable example of a poet who, with a mastery of orthodox 18th-cent technique, strove to break away from

this in the direction of Romanticism

The Romantic Revival associated with the beginning of the 19th cent was further foreshadowed at the end of the 18th cent by William Blake and Robert Burns but the reaction against classicism and established poetic convention may more definitely be dated from the publication by Wordsworth and Coleridge of *Lyrical Ballads* (1798-1800). These two poets dominated the early years of the 19th cent and between them and the true Romantics comes Byron who found his chief success in embittered satire. Shelley's poetry is a lyrical embodiment of impersonal idealism and aspiration towards an unrealisable Utopia whereas in that of Keats there flows the blood of human passion and the love of beauty in all its manifestations—the identification in fact of truth with beauty.

The Victorian era of poetry is inevitably associated with the smooth music of Tennyson the deliberate staccato and ruggedness of Browning the dreamy romanticism of the Pre-Raphaelite School and later with the frank sensuousness and metrical mastery of Swinburne and the religious mysticism of Francis Thompson.

It is too early yet to view the poetry of the present century in its true perspective but there are certain names about whose permanent place in literature there can be no doubt. Thomas Hardy Robert Bridges A. E. Housman Rudyard Kipling John Masefield W. B. Yeats Rupert Brooke and J. E. Flecker are established poets. This at least can be said that although in a commercial age poetry is hardly a paying proposition it continues to live and always will live in England.

DRAMA

After the Mysteries (qv) and Moralities (qv) the next step in the development of the drama in England was the Interlude which consisted of a short dialogue between two or three characters representing

various trades or types. Examples of this kind of performance are Skelton's *Interlude of the Four Elements* and Heywood's *Dialogue of Gentleness and Nobility*. More nearly approaching in form at least to the modern conception of a play was the Comedy as developed upon the model of Plautus (qv) by schoolmasters for presentation by their pupils and of such the most famous example is *Palph Roister Doister* written not later than 1552 by Nicholas Udall who was successively head master of Eton and Westminster. Another famous early comedy is *Gammer Gurton's Needle* (c. 1570) of uncertain authorship rustic in diction but not entirely devoid of a certain rough humour. The earliest English Tragedies are *Gorboduc* (1562) written by Sackville and Norton and Hughes's *The Misfortunes of Arthur* (1587) the model for which was obviously Seneca (qv). They have little but historical interest and are in fact barely readable. Of greater interest are the early Chronicle Histories such as *The Famous Victories of Henry the Fifth*, *The Troublesome Raigne of King John* and *The True Chronicle History of King Lear* which apart from certain elements of their own provided much of the material from which Shakespeare shaped his *Histories of Henry V*, *King John* and *King Lear*.

Before considering the predecessors of Shakespeare and the Elizabethan drama in general it is most necessary to understand a little of the circumstances of the Elizabethan stage. The tremendous vitality and strength of the drama of this age is emphasised by the very great difficulties of various kinds with which it had to contend. Almost in its infancy the drama was cumbered in the toils of the Marprelate Controversy (qv) which besides putting a stop for a time to all stage plays had a degrading effect upon the stage by making it the medium of scurrilous political invective and bringing the whole profession of acting into a state of chaos from which it only emerged when c. 1594 the various bitterly

jealous rival companies of actors were resolved into two well-organised companies—those of the Lord Chamberlain and the Lord Admiral—and the Children of the Chapel. The character of the audience, moreover, inevitably affected the nature and quality of the plays presented before it, and in this connection it must be noted that in Elizabethan times plays were always performed in the afternoon, at a time when only those who had nothing else to do could attend the theatre. In addition to all these difficulties there were the actual structural and mechanical limitations of the theatre and stage. The stage was extremely primitive, and scenery was unknown. Yet in spite of all its difficulties, to a certain extent very probably because of them, the Elizabethan drama grew and flourished in a manner unequalled by that of any other age or country.

The earliest representative dramatists of the Elizabethan age were a group of what have been named the "University Wits." Lyly, Peele, Greene, Kyd, and Marlowe. Of these Lyly is noteworthy for his use of prose and natural dialogue, Peele and Greene were pioneers in the moulding of blank verse, Kyd handled the *tragedy of blood* with no mean success, and Marlowe (1564–93), as a poet of the first order and the weaver of majestic blank verse, was the true forerunner, in some respects the master, of Shakespeare.

For a particular account of Shakespeare's work the reader is referred to the article SHAKESPEARE. It is sufficient here to say that he took up the threads of the drama as he found it, and wove them on the frame of his genius into a many-coloured tapestry in which every human emotion and aspiration is immortally portrayed.

Shakespeare is so pre-eminently the greatest English dramatist that it is easy to overlook the fact that, even without him, the Elizabethan age would still be one of the most remarkable in the whole history of the drama. Of his contemporaries and immediate

successors Ben Jonson (1573–1637) had the greatest vigour and the widest genius, but it would be possible to enumerate a long list of dramatists whose work, now read by few but students of literature, would amply justify more universal recognition. Beaumont and Fletcher, Dekker, Webster, Tourneur, and Heywood, are only a few of them. The last noteworthy dramatists before the closing of the theatre by the Puritans were Ford and Shirley.

In point of strict fact it was not the Puritans who closed the theatre, though it was they who were responsible for keeping it closed during the Protectorate. The public performance of stage-plays was prohibited, as a war-time measure, by Act of Parliament at the very outbreak of the Civil War in 1642. But the drama never entirely died in England. Plays were still published, even if they were not acted, and at the various fairs some form of dramatic performance was not infrequently to be seen, also, private performances were given at noblemen's houses. Thus there survived a thread connecting the Elizabethan drama with that of the Restoration. Sir William Davenant, indeed, used his ingenuity to devise a means of circumventing the law, and produced his plays quite openly in the "Cockpit" some years before the Restoration.

The Restoration dramatists were largely influenced by French models, and the lack of original inspiration was further manifested by the fashion for remodelling and modernising many of Shakespeare's plays. The best example of these last is *All for Love* (1678), Dryden's version of *Antony and Cleopatra*. Tragedy is poorly represented during this period, and it is enough to mention Dryden's *The Conquest of Granada* and the *Venice Preserved* of Thomas Otway (1652–85).

The comedies are far more memorable. It is only natural that they should faithfully reflect the general licentiousness of the period, and too much emphasis may be, and often has been, laid on this, after all, merely

incidental characteristic of Restoration comedy. In the hands of such men as Etherege, Wycherley, Congreve, Vanbrugh, and Farquhar it became the vehicle of sparklingly witty dialogue and relentless exposure of the vices and foibles of society.

Eighteenth-century literature is not remarkable for its dramatic production. Addison's blank verse tragedy *Cato* (1713) enjoyed a phenomenal success and a reputation which has not survived. Gay is once more remembered owing to a recent popular revival of *The Beggar's Opera* (1728). But it was not till later in the century that the drama touched greatness in Goldsmith's *She Stoops to Conquer* (1773) and the scintillating brilliance of Sheridan whose comedies were written between 1770 and 1781.

Throughout the greater part of the 18th cent. the drama maintained an undistinguished mediocrity. Byron and Shelley and later Tennyson and Browning among other poets wrote fine dramatic poems but few of these were really suitable for stage production. Public taste had sunk to a low level and as always it was the public taste which had to be satisfied. The stage was busy enough but its work bore little relation to literature and even so great an actor as Sir Henry Irving could be fed with little or no contemporary drama worthy of his art. A very special place is occupied by Sir W. S. Gilbert's libretti of the Savoy Operas but the drama had to await its true revival in the work of Oscar Wilde, H. A. Jones and A. W. Pinero. The fame of George Bernard Shaw is justly established. Mention should also be made of Sir James Barrie, John Galsworthy, John Masefield, Frederick Lonsdale, Somerset Maugham, St. John Ervine and Noel Coward.

Finally a reference is due to the group of Irish dramatists founded by George Moore and W. B. Yeats and associated also with A. E. and Lady Gregory. The greatest of them was J. M. Synge.

PROSE (since c. 1500)

Prose was far slower to develop in English than poetry. The reason for this may in part be that while poetry is in its origins the medium of spontaneous not-to-be-denied utterance, prose is the outcome of reasoned and deliberate purpose and for this Latin had for centuries been the recognised language.

Sixteenth-century prose consisted very largely of translations from the classics and other languages which reached a higher level of excellence than did any original work of this period. Tyndale's and Coverdale's translations of the Bible appeared in 1535 and 1538 respectively, the Prayer Book in 1549, Berners' *Froissart* in 1503-5, North's *Piers Plowman* in 1579 and to carry this series of great translations over into the next century Florio's *Montaigne* in 1603, the Authorised Version of the Bible in 1611 and Urquhart's *Rabelais* in 1653.

Apart from the translators one of the earliest moulders of English prose was Roger Ascham whose *Toxophilus* (1544) and more especially *The Schoolmaster* (1570) manifest a not unsuccessful endeavour to adapt the vernacular language to clarity and lucidity of expression. In 1578 appeared Lyly's *Euphues* which gave its name to the style of writing known as Euphuism (*qv*) and was most successfully imitated in Lodge's *Rosalynde* and Greene's *Pandosto*. The two last are examples of the Elizabethan novel; they tell the stories upon which Shakespeare based his *As You Like It* and *Winter's Tale* but they can hardly be considered as ancestors of the novel as that word is now understood. Sidney's *Arcadia* (1590) like practically all the prose of this period is characterised by a rather artificial ornateness.

In Hooker's *Laws of Ecclesiastical Polity* (1594-7) we find an intricate complexity of style which is unfair to the genius of the language.

and we must turn to Bacon, and especially to his *Essays* (1597, 1612, 1625) for English prose which shows a mastery of lucidity, economy, and condensation, while preserving perfect balance and rhythm. But if we consider prose in the absolute, apart from works written in prose, there is little doubt that its greatest master at this time was Shakespeare.

The prose of the Stuart period drew very largely for its material from philosophy, religion, politics, history, and scholarship. In these several spheres the prominent figures are Hobbes, Jeremy Taylor, Robert Burton, Clarendon, Milton, and Sir Thomas Browne. Though the Latin influence is still conspicuous, native prose is here surely working out its own salvation, and this is more emphatically true, perhaps, in the case of Jeremy Taylor, for the true origins of prose lie in oratory, and it is as a preacher that Taylor was supreme. A special place must be allotted to the idyllic charm of Walton's *Compleat Angler* (1653).

To the Restoration period may be assigned the beginnings of prose as it is now understood, that is to say, of a prose style which, while remaining literary, is not absolutely divorced from the living language of human speech. Bunyan and Dryden, in their several manners, made of the language a medium for vital and artistic expression, but whereas the work of Bunyan is very largely poetical in quality, Dryden may be regarded as the father of modern crystalline prose pure and simple, and the direct forerunner of the wealth of prose writers which appeared in the 18th cent.

Apart from the beginnings of the Novel (see that heading), the 18th cent is noteworthy for the essays on all manner of subjects for which Addison and Steele, in the *Tatler* and *Spectator*, were mainly responsible. There was greater dynamic quality in Steele (1672-1729), and he was the originator of this method of administering knowledge, information, and culture to the public in

an easy and palatable form, but only Addison, with his larger and more embracing vision, could have piloted the essay to the position of dominance which it attained during the first half of this century. His influence on public opinion was probably greater than that of any English author of any period. But the greatest prose genius of the time was Jonathan Swift. For clear, incisive English, unmarred by affectations borrowed from Latin or contemporary foreign literature, for sheer vigour and freedom from stylism, Swift has few, if any, peers. He is known universally as the author of *Gulliver's Travels* (1726), but his *Tale of a Tub* is perhaps even more representative of his true genius.

To the early 18th cent. belongs also Defoe, that voluminous writer whose place in literature is difficult to assess. He may be called the father not only of the novel, but of modern journalism.

Later in the century appears the almost legendary figure of Dr Johnson (1709-84), who was for long regarded as unsurpassed and unsurpassable as a master of English prose, and, like all who have been placed on an unnaturally high pedestal, has suffered from some reactionary neglect. His great merits as a writer are, however, indisputable, even if his work is too heavily loaded with pomposity for modern taste. It is his remarkable and forceful personality which survives, and that chiefly in the pages of Boswell's immortal *Life of Dr. Johnson*. Goldsmith has qualities of geniality and good humour which come nearer to the heart of the modern reader.

Many other fields of literature yielded their first really important harvest during the 18th cent. Political economy is represented by Adam Smith's *Wealth of Nations* (1776); History by Hume and, especially, Gibbon's *Decline and Fall of the Roman Empire* (1776); Theology and Philosophy by Butler's *Analogy of Religion* (1736) and Berkeley's *Treatise on the Principles of Human Knowledge* (1710), and Politics and Oratory

by Edmund Burke than whom the latter half of the century produced hardly a greater master of English prose.

The most notable features of early 19th-cent. prose are the *Essay* and the creative criticism of Lamb, Hazlitt and De Quincy; the pedantic and unimaginative criticism of the *Edinburgh* and *Quarterly Reviews*; and Lockhart's *Life of Sir Walter Scott* (1838). The Victorian Age produced a wealth of historians such as Macaulay (memorable also as an essayist), Carlyle, Froese, Green, Kingslake, Hallam, Grote, Freeman, Stubbs and Gardiner, most of whom were specialists in one or another department of history and belong rather to the realm of historical science than to that of pure literature. In J. S. Mill, however, we meet an economist and philosopher whose manner quite apart from his matter gives him an assured place in literature, and the like may be said of Herbert Spencer, Charles Darwin and T. H. Huxley. Ruskin, William Morris and Walter Pater are artists of imaginative prose, while among later essayists mention must be made of Wilde, Andrew Lang and R. L. Stevenson. Religious controversy is richly enshrined in Cardinal Newman's *Apologia pro vita sua* (1864) and literary criticism and biography are associated with Matthew Arnold, W. E. Henley, Sir Sidney Lee, George Saintsbury, Sir Edmund Gosse, Lytton Strachey and many others.

During the present century besides many works of scholarship and criticism the essay has maintained a prominent place in prose literature. G. K. Chesterton, Hilaire Belloc and in quite another manner Max Beerbohm are among those who have excelled in this field.

THE NOVEL

In the Elizabethan Age there appeared a type of prose narrative closely modelled upon the Italian tales of Boccaccio and others to which the term novel has been

applied, but these have little relation to the real development of the novel. This is true also of Lyly's *Euphues* and its successors, and it is only in the vigorous realism of such a work as Nashe's *Jack Wilton* (1594) that we can trace some resemblance to the modern conception of a novel. A far closer though still remote relationship can be recognised in the delineation of such characters as Sir Roger de Coverly by Addison and Steele in the *Tatler* and *Spectator* and more particularly in the work of Daniel Defoe (c. 1650-1731) for whom it would not be difficult for his enthusiastic admirers to claim the credit of developing more than one type of modern literature. In *Moll Flanders* and *Colonel Jack* and above all in *Robinson Crusoe* he certainly came very near to if he did not quite attain, the spirit of the novel.

But although the gestation of the novel was slow and troublesome its growth once it had come to birth was more than correspondingly rapid, and in the work of Samuel Richardson (1689-1761) it began to assume its distinctively modern features. In 1740 his *Pamela* appeared. This was largely an experimental work and is written in the form of letters, but it fully deserves to be known as the first modern English novel. Fielding's *Joseph Andrews* came two years later and was in original intention a burlesque of *Pamela*, but it quickly lost this character and developed as a novel in its own right. These were followed by Richardson's *Clarissa* (1748) and Fielding's *Tom Jones* (1749), two of the greatest English novels of all time. The sharp contrast between these two authors reacted beneficially upon the development of the novel, for Fielding represented the leasured and gentlemanly aspect of contemporary life, while Richardson belonged in spirit to the City and to trade. The third in this group of master novelists was Tobias Smollett, whose *Roderick Random* appeared in 1748 and *Peregrine Pickle* in

strong meat, perhaps, for delicate stomachs, but splendid fare for healthier and robust digestion. Fielding's *Amelia* (1751), Richardson's *The History of Sir Charles Grandison* (1754), and Smollett's *Humphrey Clinker* (1771) complete the work of these three as novelists. But together with them, though he was less definitely a novelist, must be considered Laurence Sterne, who introduced in *Tristram Shandy* (1759-66) and *A Sentimental Journey* (1768) a note of conscious artistry and delicate humour which is unique of its kind. The tale of the 18th-cent novel would be sadly lacking in completeness without a mention of, at least, *The Castle of Otranto* (1704) of Horace Walpole, a forerunner of the romantic novel, Goldsmith's *The Vicar of Wakefield* (1766), constructionally loose, but immortalised by the charm peculiar of its author, and the *Mysteries of Udolpho* (1794) among the romantically sensational novels of Anne Radcliffe.

The period between these and the advent of the great Victorian novelists is chiefly occupied by the figures of Jane Austen (1775-1817) and Sir Walter Scott, but it would be a gross omission to make no mention of Thomas Love Peacock (1785-1866), poet and novelist, who displayed his mastery of ironical intellectualism in, for example, *Crotchet Castle* (1831). Jane Austen, though to a certain extent foreshadowed by Fanny Burney and Maria Edgeworth, was the perfecter of the "novel of the tea-table", as it has been called. There is justice in the verdict, put into the mouth of one of his characters by a recent novelist (W. J. Locke), that she faithfully immortalised the trivial. But within her narrow limits she worked with such artistry and sympathetic humour upon her apparently dull material as to produce a little series of novels which will always have an irresistible appeal to a limited number of readers. Sir Walter Scott, on the other hand, worked up the romance of the historical

novel, and although the Waverley Novels (1814-32), with their leisurely and massive movement, are a little out of sympathy with the modern spirit, although they are scarred with the marks of carelessness due to their need-prompted over-rapid production, they will always remain the delight of those who have acquired a taste for them (no very difficult process) and will therefore find the leisure to read them.

The Victorian Age was particularly rich in novelists, and of these the first to make his mark was Dickens, whose *Pickwick Papers* appeared in 1836. There can be little doubt that Dickens occupies a place as close to the nation's heart as does Shakespeare himself, and this is, perhaps, due as much to his faults as to his virtues, for these are the virtues and the faults which characterise the English nation as a whole. In his love of justice and fair play and his fierce indignation in the face of oppression and tyranny, in his zeal for righting what is wrong, and in his large humanity, and also in his slushy sentimentalism and occasional muddled thinking, he faithfully reflects much of the best and the worst in the national character. Various types of readers will always have their different favourites among his novels, but it is offered as a confident suggestion that he touched his greatest in *David Copperfield*, *Bleak House*, and *Great Expectations*.

Thackeray's *Vanity Fair* appeared in 1849 and stamped him at once as a direct heir of the 18th cent and a disciple of Fielding in particular, and it is but small disparagement of him if it has to be admitted that he never quite rose to Fielding's level. In pouring out the vials of his ridicule upon all forms of hypocrisy, he hardly succeeded in creating any character, not even excepting Becky Sharp, who is more really alive than Henry Esmond.

Charlotte Brontë performed a miracle of introspective analysis in *Jane Eyre* (1847) and *Villette* (1853),

while her sister Emily gained an imagination what she lost in realism in *Wuthering Heights*. More peaceful and redolent of the rural charm of Cheshire is Mrs. Gaskell's *Cranford* (1853). But perhaps the most famous of the Victorian women novelists was George Eliot (1819-80) to whom though she has fallen far from her once great reputation it is impossible to deny the credit of a most thorough and painstaking endeavour even if this was but dimly illuminated by the light of imagination. Of her books *The Mill on the Floss* and *Silas Marner* remain the most palatable to modern taste. Far more acceptable to the modern reader are the *Barchinshire Novels* of Anthony Trollope remarkable for their shrewd characterisation of various types of the clergy.

Although it was of so late a birth the novel became far more extensively practised than any other form of literary art chiefly because it was the least exacting in its demand for a hardly won technique. The pre-eminently great novel is as rare as for example the really great poem but a reasonably good novel can be written with less special qualifications than can the reasonably good in other departments of literature. So it is that at about the period now under consideration there appeared so many novelists that the task of selection becomes embarrassing.

Among historical novelists were Benjamin Disraeli, Harrison Ainsworth and Bulwer Lytton some of whose books may continue for some time to have a limited appeal and a more permanent place may perhaps be allocated to the *Hypatia* and *Westward Ho!* of Charles Kingsley and Charles Reade's *The Cloister and the Hearth* and *It is Never too Late to Mend*. Mrs. Henry Wood and Ouida enjoyed an enormous contemporary reputation which has by no means entirely vanished. There has been an over-delayed revival of interest in Wilkie Collins's ingenious exploitation of mystery thrill and detection. Of

many great novels which owe much of their interest to the localisation of their scenery and characters a foremost place may be given to the *Lorna Doone* (1869) of Blackmore who has been followed as a delineator of the Devon character by Eden Phillpotts while Sir James Barrie and others set their scene in Scotland. But the greatest of the local novelists was Thomas Hardy who as William Barnes had previously done in another manner through the medium of dialect poetry placed Dorsetshire permanently on the literary map of England.

R. L. Stevenson in *Kidnapped* (1886) and *Treasure Island* (1883) gave memorable expression to the romance of history and of adventure respectively. Religion and Christianity are in their several manners the mainspring of Shorthouse's *John Inglesant* of Hughes's *Tom Brown's School-days* of the *Robert Elsmere* of Mrs. Humphry Ward and of that remarkable posthumous novel of Samuel Butler *The Way of All Flesh* (pub. 1903). The list of great Victorian novelists may be completed with the names of George Meredith and George Moore each of whom has definite affinities with the great 18th cent. novelists but before approaching the younger modern writers it should not be forgotten that Kipling justly more famed for his short stories wrote also *The Light that Failed* and *Kim*.

Of recent or living memory are the vivid sea-stories of Joseph Conrad the *Forsyte Saga* of John Galsworthy *The Old Wives' Tale* to select but one of Arnold Bennett's novels and the fanciful use of scientific speculation made in his earlier work by H. G. Wells. It is only possible to make a tentative selection of other living novelists with every sense of the danger of flagrant omission but it is impossible to ignore the qualities of at least Hugh Walpole, E. F. Benson, Compton Mackenzie, Rose Macaulay, Aldous Huxley and that master of the humour of verbal felicity P. G. Wodehouse.

Engraving: (1) The art of cutting a design on a hard substance, including inscription on stone, incised decoration of gold and silver, cameos, etc., but chiefly the making of pictures on wood or metal for the purpose of printing impressions from them in ink on paper. (2) The impression so made. In *wood engraving* (*q.v.*) the part to be inked is left in relief, while the rest is cut away; in *metal engraving* the whole plate is first inked, then the ink wiped off the smooth surface and left in the incised lines, from which it is forced out on the paper by pressure in printing. Copper is the metal most often used. Steel gives a larger number of clear impressions, but is harder to engrave. An engraved copper-plate can now be coated electrolytically by a very thin layer of steel, which protects it against the flattening effect of the press, and gives a longer useful life. There are various ways of engraving, which have been used by artists either separately or in combination, in executing their designs. *Line-engraving* proper is done with a pointed steel "burin" or graver, pushed between the artist's forefinger and thumb to cut a clean furrow out of the plate. *Dry-point* throws up the metal to one side of the cut in a "burr," which holds some of the ink and gives a softer edge to the lines. *Mezzotint* obtains the effect of tone by first roughening the whole surface with a "rocker" worked in two directions, then burnishing away the high lights, removing part of the "burr" for the lesser shadows and leaving the dark parts to retain most of the ink. *Etching* is a process of "biting" the metal, by immersion in dilute nitric acid (or sometimes iron perchloride), after protecting the back of the plate with Brunswick black, covering the face with smoked wax, and drawing through the wax with a sharp "needle" to expose the metal where lines are required. The depth of "biting" can be varied in different parts by "stopping out" the highest lines with varnish after a short time, and placing

a second or even a third time in the acid for the darker lines. When the wax is cleaned off, the plate is ready for inking and printing. For *soft ground etching* the wax is mixed with tallow, and the drawing made in pencil on thin paper stretched on top. The "ground" of tallow and wax adheres to the paper and comes away in the parts touched, leaving the metal exposed in a broader line. *Chalk or crayon engraving* is an attempt to produce a broken line by means of a "roulette," which makes a series of dots through the ordinary wax "ground." *Stipple* has flicks or dots added by engraving after the etching. *Aquatint* is an etching process in which the "ground" consists of minute grains of resin, deposited on the plate by evaporation from a spirit solution. Where the etching needle removes these, there are no hard lines, as the whole ground is porous and the metal is etched very slightly all over, giving the effect of a wash rather than drawing.

When the "plate" has been engraved or etched by the artist, the ink is put on by a "dabber," and carefully removed from the untouched surface by a sheet of coarse muslin. The "press" has a board sliding between two rollers, and printing requires slightly damp paper. Great pressure is needed to force the ink out of the grooves in the plate and a "plate line" thus is left, sunk into the paper, unless the sheet is of the same size as the print. The earliest "impressions" are valued most, as in the case of the "old masters" the plates were sometimes touched up or reworked by their pupils when they became worn. The manifold reproduction of engravings and etchings is now possible by *electro-type* (*see* PRINTING), *photo-engraving* (*q.v.*), and *offset printing* processes (*see* LITHOGRAPHY), mechanical aids, such as "ruling machines" for the parallel lines in skies and backgrounds, can be used. Among purely commercial applications are steel-plate engraving for bank-notes, the engraving

ing of maps and plans (by tracing through wax on to copper and electro-typing from this) and copper plate engraving for visiting cards or invitations now reproduced by a pantograph arrangement in which master letters are drawn round by hand and a stylus at the end of a movable arm cuts them through the etching ground on to the plate.

History The earliest date on an intaglio engraving is that of the *Flagellation* in a Passion series by the so-called Master of the Playing Cards in Germany (1440) though some historians believe that the art arose first in Italy from the niello ornaments of silver and gold engraved and then inlaid with black fused sulphides of copper. There are scarcely any prints of niello before 1450 but the goldsmith's tendency to decorative detail is shown in the line engravings of Maso Finiguerra of 1460 and of the Master F.S. in Germany in 1460 and 1467. Martin Schongauer (c. 1470-1485) however concentrated more simply on the central theme with the distant landscape in outline and in Andrea Mantegna (1431-1504) we have masterly expression and dignity and classical beauty of figure which show the true artist. Albrecht Dürer (1471-1528) the first great engraver in Germany with his clear outline and delicate system of cross-hatching of the darkly shaded background excelled in presenting many figures in a limited space and yet throwing into relief the expressions of the foremost actors as in his

Passion prints. Lucas van Leyden (1494-1533) was an accomplished worker with a softer line than Dürer's treating more homely subjects. The Little Masters who followed Dürer were so called from the small size of their plates. In Italy Marcantonio Raimondi (c. 1489-1540) was less original and is best known by his engravings of Raphael's pictures. Etching which had long been practised by the goldsmith and the armourer was first used for artistic reproduction

by Dürer (with iron plates) in 1516 and 1518. In Holland Henry Goltzius (1558-1617) developed a delicate tone in his portrait engravings by swelling or diminishing the breadth of his individual lines but the end of the 16th cent saw the decline of original engraving partly through the activity of the print sellers who acquired plates printed as many impressions as possible and employed engravers to rework these when worn. Later arose the schools of engraving which were fostered for the reproduction of their



Adam and Eve. Engraving by Albrecht Dürer

paintures by Rubens and Van Dyck. Lucas Vosterman (c. 1590) and Paul Pontius (c. 1596) were among the pupils whose work was superintended and corrected by Rubens while Van Dyck etched 18 plates of his Iconography for his pupils to engrave. In England the first copper plates were illustrations by Cennino in Vesalius Anatomy (1540). William Rogers (c. 1545) is famous for his full length portrait of Queen Elizabeth (after Oliver) showing a goldsmith's love of detail in the ornament of the Tudor costume.

The 17th cent in France saw the rise of the great portrait engravers, Claude Mellan (1598-1688), with his characteristic shading in parallels, and no outline, Jean Morin (c 1600-1660), who combined engraving with etched dot and line, Robert Nanteuil (c 1629-1678), a pure engraver, with delicate modelling of the face by close short strokes, Gerard Edelinck (c 1640-1708) and Antoine Masson (1636-1700). In the Netherlands Cornelis van Dalen, and in England William Faithorne, engraved portraits of Charles II. Of the great masters of etching Van Dyck (1599-1641) was distinguished by the economy of his line, and concentration on the outstanding features of his portraits, while Rembrandt (1607-1669) combined an elaboration of modelling with delicate hatching. Only 5 pure etchings of Van Dyck are left, including portraits of "Peter Brunsels, the younger" and "Erasmus", the rest were used afterwards for engraving. Rembrandt, on the other hand, left not only numerous portraits of himself, his mother, and others of his family, but genre pictures such as "The Blind Fiddler", scriptural—"Christ with the Sick around Him, receiving little Children," and "The Crucifixion," and landscape etchings. He was followed by Ferdinand Bol (1611-1681) with "A Philosopher Meditating," and later by Adriaen van Ostade (1610-1685) with the "Man with the Hurdy-Gurdy" and "Saying Grace", by Jacob van Ruysdael, with landscape and Renier Zeeman, with seascapes, and architectural plates. Claude (Lorrain) (1600-1682), working in Italy, showed tenderness of tone, Wenzel Hollar (1607-1677), a native of Prague working in England, a delicate technique, while Jacques Callot (1592-1635), with a genius for caricature and the grotesque, also achieved atmosphere and variety.

During the 18th cent mixed methods of engraving and etching were practised in France, following Gerard Andran (1640-1703), by the Watteau

school of engravers, while Jean Georges Wille (1715-1807), and Friedrich Schmidt (1712-1775) in Germany, revived pure engraving. In England Sir Robert Strange (1721-1792) etched his outlines and lighter tones, and then reworked with the graver, as did William Sharp (1749-1824), and William Woollett (1735-1785). Augustin de St Aubin (1736-1807), with his frontispiece portraits, and Jean Moreau le jeune, with his pictures of contemporary life, are among the famous illustrators of the 18th cent in France, while in England, Thomas Stothard (1755-1834) did graceful work. William Blake (1757-1827)—for his own books—etched both text and design "in relief," biting away the background. Daniel Nicholas Chodowiecki (1726-1801), in Germany, illustrated small books and pocket almanacs, in a spirited manner. William Hogarth (1697-1764), with his social satires "Harlot's Progress" and "Rake's Progress," showed dramatic artistry but no sound technique in his engravings. Thomas Rowlandson's "Dance of Death" (1816), "Dance of Life" (1817), and "Vicar of Wakefield" series were etched by himself, and worked in aquatint by Rudolf Ackermann's employees. The Spanish painter, Francisco Goya (1746-1828), combined etching, dry-point, and aquatint in his "Caprichos," "Proverbios", and "Desastres de la Guerra", with an independent and cutting style of satire. Meanwhile, for the reproduction of architecture John Sell Cotman (1782-1842) used soft-ground etching, while Andrew Geddes (1783-1844) and David Wilkie (1785-1841) produced a rich effect in portraits by dry-point. The crayon manner of engraving was first employed by Jean Charles François (1717-1769) for the reproduction of drawings, and stipple was introduced into England by Francesco Bartolozzi (1725-1815) and used by William Ryland (1738-1783) to produce prints after the old masters and after Angelica Kauffman.

simple process well within the capabilities of the amateur.

Enlarging can be done either by daylight or artificial light. The apparatus for use in daylight usually consists of a rectangular box holder shaped as in Fig. 1. The negative from which the enlarged print is to be made is placed at one end and the sensitive paper at the other (in the dark room). Between them is a lens which actually produces the enlargement when the light is allowed to pass through the negative and so projected through upon the paper. In other words the enlarger itself acts as a camera, except that the image produced by it is larger than the original and positive instead of negative.

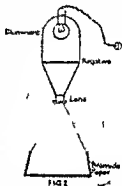
Enlarging by artificial light is in many ways more satisfactory than working with a daylight enlarger. In the first place the strength of the necessary illuminant is constant which is not the case with daylight. Secondly it is possible to obtain prints of practically any required size and to enlarge conveniently any required part of the negative. Fig. 2 shows the general arrangement of the type of apparatus now most generally used. This can be purchased complete in various sizes and forms, with or without a condenser or an arrangement can be obtained which employs the camera itself as the enlarger fitted on simply to the source of light. Of enlargers proper both self focusing and non-self focusing types can be bought. The former are a little simpler to use but there is no

enlarger if orange light is used instead of white as the general illuminant.

Negatives to be enlarged should be free from scratches, finger marks or defects of any sort. They should be perfectly hard and correctly exposed (though to some extent slight faults in exposure can be corrected or at least allowed for by choice of a suitable paper). It is well to examine each negative carefully to discover whether the enlargement of a portion of it will give a more artistic result than the enlargement of the whole.

Bromide paper of which there are many varieties is generally used because of its greater sensitivity. But gaslight paper may also be used though it requires considerably longer exposure. The paper should be chosen to suit the negative. A thin negative should be enlarged upon a so-called vigorous paper, a contrasting negative upon a soft paper and a normal negative upon normal paper. When it is desired to bring out detail to the greatest possible extent glossy paper should be used. For most other purposes a matt or velvet paper is to be preferred.

The time of exposure depends upon a number of factors: the character of the negative (whether thin or dense), the strength of the illuminant used, the type of paper employed and finally the degree of enlargement required. It is always wise to experiment by cutting a sheet of sensitive paper in strips exposing each strip in turn for a different time developing



Vertical Enlarger

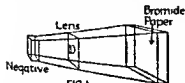


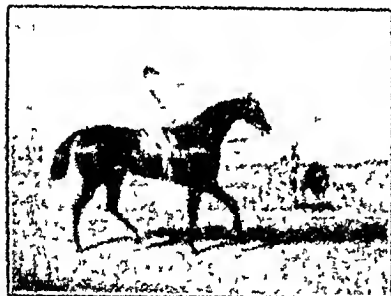
FIG 1

A Box Enlarger

reason to anticipate any very great difficulty in using the latter. There is no need for a dark room with such

of views and treatises on landscape painting, in the early 19th cent.

The first revival of original engraving came from painter themselves. Millet and Corot among them. Charles Vignon (1821-1898), with his "L'auxfortes sur Paris", showed both imagination and inventive execution. Alphonse Legros, whose first work appeared in 1851, had deep insight and forcefulness of expression combined with a broad human touch in his plates of peasant life and in his portraits. James McN. Whistler (born in America, a student in France, and working in England) is famous for dry-point engraving, and for his etching. His lines showed mastery of the



Race horses were a popular subject for Nineteenth Century Engraving. Jack Spicot, Winner of the St Leger, 1821

art of omission, and he obtained tone by the manipulation of a thin film of ink on the surface of the plate. His "Thames" set (1871), including "Price's Candle Works" and "Buttersea-Dawn," are excelled by his "Venice" set (1880) and his "26 Etchings" (1886). Seymour Haden on the other hand, used line fully yet forcibly in the play of light and shadow on the water in "Shepperton" (1864). In Holland, Charles Storm van Gravesende's treatment of landscape and sea etching stands out fresh and virile. America, in addition to Frank Duveneck, Joseph Pennell, and Mary N. Moran, has produced D. S. MacLaughlin, a Canadian who studied in Boston, an artist with the sure touch

of conviction in his architecture and landscape.

Among early 20th cent. English etchers, William Strang, a distinguished portrait artist. Sir Charles Holroyd, Frank Short, Legros and Augustus John, are well known. More recently D. Y. Cameron, with his dry points of mountain and moorland scenery, Mordaunt Bone, with his studies of scaffold-covered buildings. James McBeck and Frank Brangwyn have developed along original lines.

See also LITHOGRAPHY, PRINTING, WOOD-CUT

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Enjambement (from *ANJAMBAHMENT*), the arranging of sentences and clauses in verse so that their ends do not coincide with the end of the lines introduced in order to give fluency and ease to the verses. See also **END-STOPPED**

Enlarging, Photographic. Improvements in the manufacture of the sensitive emulsion used for plates and films, especially the latter, have given considerable impetus to the use of very small cameras, easily carried, and containing negative material sufficient for a considerable number of exposures. One of the most popular cameras of this type on the market utilises cinematograph film, and carries enough for 36 exposures. It is an instrument of extreme precision and almost universal in its possibilities. The user of such cameras, however, will almost certainly require prints larger than the negatives. To make them he will need an enlarger of some sort, and there are many enlargers on the market which produce prints up to 12 x 10 in. in size with as much ease and accuracy as may be expected in the making of a contact print. Enlarging is a perfectly

simple process well within the capabilities of the amateur

Enlarging can be done either by daylight or artificial light. The apparatus for use in daylight usually consists of a rectangular box holder shaped as in Fig 1. The negative from which the enlarged print is to be made is placed at one end and the sensitive paper at the other (in the dark room). Between them is a lens which actually produces the enlargement when the light is allowed to pass through the negative and so projected through upon the paper. In other words the enlarger itself acts as a camera except that the image produced by it is larger than the original and positive instead of negative.

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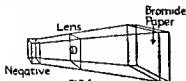
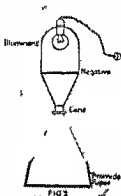


FIG 1

Action 1 Enlarg in D gram

reason to anticipate any very great difficulty in using the latter. There is no need for a dark room with such

them individually, and noting the length of exposure given, until a satisfactory result is arrived at. The correct exposure should then be noted, together with particulars of the paper used, and these details kept with the negative for reference.

Finally, the photographer who habitually uses an enlarger should employ, as far as possible, the fine-grain films now on the market. He will thus avoid any sign of "graininess" in making even a big enlargement.

Enneastyle [EN'ŪSTİL'], a Greek temple or other building having 9 columns at the front.

Enniscorthy, urban district and market town in Co. Wexford, Irish Free State. The industries in the main are brewing, tanning, and flour-milling. Barley, wheat, and roots are cultivated in the surrounding country. An annual horse-fair is held here, a ruined Norman castle may still be seen. Pop. 5543.

Enns: (1) Right-bank tributary of the Danube, rising on the Nieder Tauern chain S. of Rastadt. The general direction is first E., turning N. in Central Austria and flowing into the main river E. of Linz. Length, c. 100 m. (2) Small town of antiquarian interest on the lower river not far from Linz. The Romans had a settlement here, and there is a monastery founded in the 7th cent., with a magnificent library dating from the late 17th cent. Pop. 4200.

Enoch, Books of, two Jewish Apocalypses (*q.v.*) writings, the Ethiopic *Enoch* and the Slavonic *Book of the Secrets of Enoch*. Both are pre-Christian books concerned with symbolic interpretation of the future life, and influenced the eschatology of the New Testament.

Enschede [EN'SKĀDE], Dutch town in the province of Overijssel. It is an important centre of the textile industries, especially cotton-spinning and weaving. Pop. (1932) 51,300.

Ensign, originally any emblem, or badge of office and now a flag or banner used in the Army and Navy. The British naval ensign is red, white, or blue, with a small Union Jack in the

upper corner. The red ensign is flown by the Merchant Fleet, the blue ensign by the Royal Naval Reserve, and the white (which includes a red St. George's cross) by the Royal Navy and the Royal Yacht Squadron. The name was formerly given to the lowest rank of commissioned officers in the British Army, whose duty was to carry the colours or ensign. Their place is now taken by the second lieutenant.

Ensilage. (1) The process of storing green fodder in a silo or pit without drying. (2) The fodder so treated. Green crops are stored with all juices preserved in a circular shed measuring 12-20 ft by c. 40 ft high, which excludes air once fermentation has displaced that which entered among them. Certain acids form, preventing the growth of mould, but care in packing is necessary, or other harmful acids may turn the crops sour. Some crops are partially dried before ensiling.

Entail, a system of land tenure introduced by the statute *De Donis*, 1285, by which the holder has only a life interest in his land, which passes on his death to his heirs.

Entente Cordiale, the semi-formal alliance between England and France before the World War, sometimes known as the Triple Entente, meaning the alliance of England, France, and Russia as opposed to the Triple Alliance of Germany, Austria-Hungary, and Italy. In 1903 France was seeking that in any conflict with Germany Britain should at least be neutral. In 1904 an agreement concerning Morocco was signed. France was to be given a free hand in Morocco, in return England was to be free in Egypt. This led directly to the Conference of Algeiras (*q.v.*), and widened the breach between the Entente and the Triple Alliance. The change in England's Government in 1906 and the advent of Sir E. Grey as Foreign Minister made the Entente a closer bond between the two countries, and Great Britain was by 1914, even apart from the invasion of neutral Belgium, committed, in honour at least, to French alliance.

This second stage of the Entente was marked by increasing friendliness between England and France's ally Russia. Germany's abandonment of Bismarck's policy of friendship with Russia enabled the French to approach closer the more so as Russia was opposed to Germany's ally Austria-Hungary over the Balkan question (qv). France brought together England and Russia and in 1907 England gained Russia's goodwill by her non-interference in the Bagdad railway project. Further Anglo-Russian differences were settled by an agreement which defined spheres of influence in Persia and established a small Persian neutral zone between them. Europe thus divided into two groups the Entente and the Triple Alliance.

Enteralgia, see COLIC

Enteric Fever a term often applied to typhoid fever as more indicative of the intestinal lesions met with in that disease. It may be due to any of 4 different bacilli hence it is now divided into typhoid fever and 3 kinds of paratyphoid. See also ENTERITIS

Enteritis, a convenient term for disorders of the bowel in which there is inflammation of the lining of the bowel wall. This condition is referred to under BOWELS (qv). The varieties of enteritis which will be considered here are dysentery, mucous colitis, typhoid fever, also known as enteric fever, and paratyphoid fever.

The two diseases known as dysentery and mucous colitis are so similar in the effects which they produce that without carrying out a very detailed investigation such as will presently be described it is impossible to distinguish between them. The disease in both takes the form of a detachment of the mucous lining of the bowel wall with the result that a raw surface is left which is exposed to intense irritation by the contents of the bowel. The result is that a very persistent form of diarrhoea ensues.

In the case of dysentery two micro-organisms have been found either of which will produce the disease, not in

the case of mucous colitis no organism has been discovered and its cause remains obscure. Dysentery when it occurs in the tropics is produced by a small animal known as an amoeba (qv) which is carried by the fingers of servants and others handling food and receives the name of *Entamoeba Histolytica*. When the disease occurs in non-tropical countries in time of war or even in asylums—where the inmates have curious habits—in times of peace it is often due to a true bacterium present in drinking water or carried to food by flies known as the bacillus of Shiga or Flexner.

Prevention of dysentery can be secured only by clean habits of personal hygiene and efficient purification and protection of water supply on a large scale.

Typhoid and paratyphoid fevers are likewise similar diseases but are caused by distinct organisms. In the case of paratyphoid the disease may be caused by yet further varieties of organism the two most important of which are known as A and B.

Infection by these organisms always takes place by swallowing them. The source of infection is always the excreta of an infected person, and the vehicles in which the bacteria may spread are water, milk, food and flies. Fresh green foods as for example salads are particularly dangerous in countries where typhoid fever is common and where infected excreta may contaminate the soil. Cooked foods are not so dangerous unless they are of the variety which are handled and sold cold in which circumstances they are liable to infection from such people as cooks and milkmen who happen to harbour the germs. Shellfish such as oysters were at one time a common source of infection in this country because they breed best in places where the water is liable to be infected.

The actual form which these diseases take varies considerably. They are really a general infection of the whole body though it is primarily the bowel that is

the condition in the bowel which gives rise to complications which make the disease so serious. When the bacilli have entered the intestine they are absorbed into certain parts of its wall, where they multiply, and lead to a detachment of the bowel lining with the formation of ulcers. The most dangerous complication is that in which these ulcers perforate, because this leads to a condition of general peritonitis (see ABDOMEN).

The bacilli also spread to other parts of the body, being conducted from the intestine by the vessels of the *Lymphatic System* (q.v.), whence they are discharged into the blood-stream. It is this general spread that gives rise to all the symptoms and signs of fever in the body. There is usually a gradually rising temperature associated with a feeling of chilliness and loss of appetite. Severe headache may then develop, and there is abdominal pain, accompanied by constipation or diarrhoea. Rose-coloured spots frequently appear on the skin. Most characteristic of all, however, is the development of the "typhoid" state, in which the patient lies comatose and still for day after day.

Typhoid itself may, however, be quite mild, while paratyphoid "B," which still occurs in this country, is normally mild. In either disease the patient may not feel ill at all, and may, in fact, be ambulatory. There are people who harbour the germs and are ignorant of the fact, and these are a source of great danger to their fellows, especially if they are employed in the handling of food. These people are called carriers.

The diagnosis of the disease, whether it be severe or only in carrier form, depends upon an agglutination test of the patient's blood similar to that used in the case of bacillary dysentery, but in this case of course typhoid and paratyphoid respectively are employed in the tests. The diagnosis is also sometimes made by isolating the bacilli from the blood, from the urine, or from the stools.

The protection of the community at large depends mainly upon the protection of water supplies. The detection of carriers is a very difficult problem, and when they are detected, they are very difficult to cure of their carrier state. Although it may seem hard to deprive them of employment, nevertheless, once they are detected, they should never knowingly be employed in the catering trades. Oysters are now subject to very careful periodic examination, so that in eating them in this country to-day there is little to fear. See also BOWELS.

Entomology, the branch of zoology dealing with insects (q.v.).

Entomophilous Plants, those dependent on insects for the transference of pollen. The flowers are brightly coloured and sweetly scented to attract insects, and frequently secrete honey from glands within the petals. One trend in the evolution of the flower has been towards cross-pollination, and the agents of this are wind (anemophily), occasionally water, and, most usually, insects. Cross-pollination, i.e. the bringing of pollen from the anthers of one flower to the stigma of another of the same species, where it germinates, is beneficial, as the progeny varies, within narrow limits, and the chances of survival of some individuals of the race increase with the range of slight variations, in any fixed environment or one changing slightly. It was assumed that the bright colours of flowers attracted insects who sought the food within the nectaries of the flower, but Hess, in 1913, suggested that bees are colour-blind and Frisch (1914) showed that bees are colour-blind to red and green. Kuhn and Pohl found that bees distinguish between yellow, blue-green, bluish violet, and ultraviolet regions of the spectrum.

The nectaries are usually placed so that the hairy body of the visiting insect touches first the stigma and then the anthers. The anthers of one flower dust the body with pollen grains which adhere to the sticky stigmas of

the next flower. The pollen grains of entomophilous flowers have a sticky or rough surface often with spiny projections. The structure of many flowers is adapted for insect pollination thus many flowers have long tubular throats opening into spreading petals. The conspicuous petals attract the insect and the cylindrical envelope of the essential organs ensures that the insect's body brushes first stigma and then anthers as the visitor goes down to the nectar secreted at the base of the tube.

Where the lower petals are enlarged for an alighting platform and the upper petals curve over to protect the anthers from rain the flowers are called *zygomorphic* (i.e. having one plane only of symmetry) to distinguish them from flowers in which all the petals are equally developed such as the primrose which is *actinomorphic*. Actinomorphic flowers were the earlier form and zygomorphic flowers have developed from them later but both are usually entomophilous. Some flowers are entirely dependent on one kind of insect for pollination in others the pollen can germinate only if the stigma is rubbed by an insect which as a rule will bring foreign pollen.

Entrées An entrée is a made dish usually complete in itself consisting of meat poultry or fish vegetable and sauce. It precedes the roast course in a formal menu and if both a hot and a cold dish of the type are served the former precedes the latter. The following are types of entrées details of which will be found under their separate headings: *Aspics, beef olives, blanquettes, casseroles, collops (minced), chaudfroid, croquets, curries, escalopes, filets, fricassées, galantines, grenadine, hachis, quenelles, ragouts, rissoles, soufflé, soufflé-creams, tymbales*.

Borders can be of potato or rice either straight or round and are often used to improve the appearance of entrées. If rice is used it may be applied cold.

Potato Border

1 lb cooked potatoes

1½ oz butter

1-2 tablespoonfuls milk (boiling)

1 egg yolk

Salt and pepper

Add mashed potatoes, hot milk, egg yolk and seasoning to melted butter. Beat thoroughly until it ceases to cling to spoon or finger. Turn out on to floured board. Roll out into a rod-shaped piece and arrange in a circle or oval on a dish. Mark with the handle of a knife or a fork which has been dipped in hot water. Brush with egg and brown in hot oven. A similar mixture can be made with a straight border.

Rice Border The rice is cooked as for curry (see CEREALS) and formed into a border with a fork or moulded. In the latter case the cooked rice is put in a well greased plain border mould steamed for about ½ hour and then turned out. A beaten egg may be added to the rice before putting it into the mould.

Entrenchments earthworks raised in warfare to protect soldiers either simple earth banks thrown up for temporary refuge or elaborate passages up to 8 ft deep connected with dugouts and permanent defence works.

Entrepôt Trade in one centre in the goods of other countries. London is a great centre of entrepôt trade. There rubber from Malaya, wool from Australia, gold from S. Africa etc. are sold to all parts of the world. See also FOREIGN TRADE.

RE EXPORTS

Entre Ríos [EN TRÁ RÍOS] N.E. Argentine province watered by the Rr. Panama and Uruguay. The entire area is lowland and in places swampy but fertile producing wheat and vines. Large numbers of cattle are raised and the forests which cover a wide area cultivated. After a stormy past the province is developing into one of the most important economic areas in the Republic. Area 30 240 sq. m. pop. (1932) 678 800.

Entzheim, see SINSHEIM

Enver Pasha (1881-1922), leader of the "Young Turks" joined the Young Turk Party in the revolution of 1908, when Sultan Abdul Hamid was compelled to grant a constitution. He later took part in the Italo-Turkish War and the Balkan War of 1912. Opposing the cession of Adrianople to Bulgaria, he encompassed the death of the War Minister, Nazim Pasha, and formed a "Young Turk" Cabinet, with himself as War Minister. He promoted the alliance of Turkey with Germany during the World War, and, after Turkey's surrender, fled to Russia. He was killed in Bukhara during a campaign against the Soviet

Environment, in biology, term for the sum total of the agencies and conditions which influence the development, life, and death of an organism, species, or race. The agencies are physical, chemical, or material, and, in the case of man, mental and spiritual also. Adaptation to environment is the main reason for the structural changes accompanying the evolution of plants and animals.

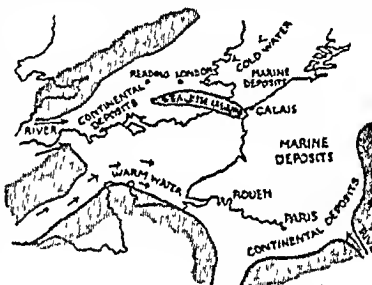
Envoy: (1) a person who is sent on a mission as a diplomatic agent ranking next after an ambassador (see LEGATION). (2) The concluding half-stanza of certain fixed poetical forms, e.g. the *ballade* (q.v.). It frequently begins with a word of address to some person.

Enzeli, see PAHLEVI

Enzymes, substances which convert organic compounds into simpler substances, and are formed by micro-organisms or cells of plant or animal bodies. An example is zymase, which is formed by the yeast cells in the fermentation of sugar and converts the latter into alcohol and carbonic acid gas. See also BIOCHEMISTRY.

Eocene [pron E-ō-e-NE] System, the oldest of the four geological systems into which the Tertiary era (q.v.) is divided. The name is derived from two Greek words meaning "Dawn of recent," and was applied to this period because the strata include a small proportion of fossils then regarded as the same as

certain existing species. It is probable, however, that no actual species have survived since Eocene times. The Eocene typically occurs between the Upper Cretaceous (q.v.), or Chalk (below), and the Oligocene (above), but in S. England and France there is continuity between the Eocene and Oligocene, and the latter was formerly included in the Eocene. Continuity between the Chalk and the Eocene is rarer, but does occur in Denmark and Scandinavia. Apart from these outcrops, and some localised deposits in Central Europe, the European Eocene exhibits two types of deposit. In the Mediterranean area marine deposits were laid down, while in the Anglo



The Anglo-Franco-Belgian Basin

Franco-Belgian Basin was deposited in succession of alternating marine and continental beds, whose succession has been worked out in detail. This Basin was a partly enclosed sea, probably open to the N.E., and connected temporarily at various times with the Mediterranean. It is assumed that at least two great rivers brought masses of sediment into this shallow gulch. One flowing from the W. discharged its contents into the subsidiary basins of Hampshire and London, the other probably arising to the S.E., entered the basin in the Paris area. The incipient earth movements which later culminated in the elevation of the Alps raised the bottom of this basin, causing the sea to spread in all directions. When movement ceased, the river again laid down freshwater sediment

verifying the recently deposited marine
rocks

A repetition of such movements occurred throughout the Eocene system. This has been attributed to the slow uplift of the dome of the Weald of S.E. England which was probably an island in this basin.

The Belgian area of the basin was comparatively tranquil and a succession of shallow marine deposits of clay and sand was laid down there.

The succession of deposits in England is more complete in the Hampshire than in the London Basin but in both the beds are mainly continental in character to the W and become pre dominantly marine to the E. In fact they form wedges of strata

Very thick deposits of Eocene beds are found in the Alps where they are folded and altered by metamorphism.

Alps was laid down a deposit termed the Gysch (g r) apparently detrital in origin. The Vienna sandstone is a deposit of similar origin.

The deposits of nummulitic limestone



Europe in Ecene Times (After 11 A.D.)

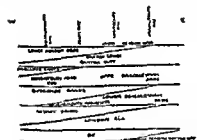


Diagram of Eocene Deposit of the Hampshire Basin.

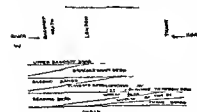


Diagram of Eocene Deposits of the London Basin

They are chiefly limestones characterised by fossils of the Eocene and Oligocene. To the N of the

stretch E. through the Balkans Asia Minor and Persia to India. They are the characteristic deposits of the deep narrow sea called Tethys which covered the site of the present Mediterranean and Alps and extended far to the E. sending out gulfs over Egypt and the Atlas area and even Burma, Assam and the E. Indies. In the Burmese area the deposits of Eocene beds are 10 000 ft. thick. The Eocene of N. America was laid down in basins fringing the areas of the present coast while continental deposits were formed over the present interior of the continent. Coal is found in the Eocene of Washington. The Eocene of the continents of S. America, Africa and Australia outcrops as deposits fringing the continents wholly in those times had a their present configuration.

a little volcanic activity in the Eocene, as in Italy and N and S America.

The climate was probably warm at first, becoming cooler towards the close of the period, and that of Europe, judged by the fossil forms, was much as it is to-day. Besides the mammulites, which are the main fossils by which the beds are correlated, the most conspicuous character of the fauna is the beginning of the predominance of Mammals. The great Reptiles of the Mesozoic had practically died out, and the Mammals replaced them, some modern forms being already present. The same is true of the Birds. Among Invertebrates the chief difference from the Cretaceous is the dominance of gastropod and lamellibranch molluscs and the comparative decline of cephalopods.

Eolithic Period, see STONE AGE

Eos [É'ōz], Greek name for *Aurora*, the goddess of Dawn.

Eosin, the potassium (or sodium) salt of tetrabromo-fluorescein, a red compound which possesses brilliant fluorescence in alkaline solution. It is used (in acid solution) as a red dye for wool and silk, and is the colouring matter of most makes of red ink.

Eozoon, a structure found in the pre-Cambrian or Archaean limestone of Canada, and at one time regarded as a fossil, probably a reef-building foraminifer (*q.v.*). Had this been proved, Eozoon would have been the oldest relic of life yet found. But it so much resembles certain mineral structures found in other rocks, such as limestone, which has been altered by heat, that it is now considered inorganic in origin.

Epaots, see CALENDAR

Epaninondas (c. 418-362 B.C.), Theban general and statesman. As democratic delegate for Thebes at the Spartan Congress of 371 B.C., he refused to cede the Boeotian cities allied to Thebes, and by a victory at Leuctra destroyed Sparta's supremacy in the Peloponnese. He subsequently freed Messenia, and finally overthrew the

Spartan league at Mantinea, but fell in the battle. Epaninondas developed a new military strategy which proved highly successful.

Eparchy, originally the name given to a province in the E. Empire, under the rule of an *Eparch* (equivalent to *prefect*); it survives as the name of an administrative subdivision of Greece and of a diocese of the Russian Orthodox Church.

Epaulette [epō'let'], an ornamental fringed tab or badge worn on the shoulder (fr. *épaule*) as a distinguishing mark of rank. A gold epaulette was worn by British Naval officers in 1795, following the French adoption in 1759. In the 19th cent. decorative epaulettes were used on military and naval uniforms in all countries, but were abandoned in the British Army in 1855, though retained in the Navy above the rank of sub lieutenant. They are possibly a survival of the mediæval shoulder-piece.

Épée-de-Combat [i pād'kombā], a pointed, dull-edged sword, with blade c. 3 ft. long, used in duelling and fencing. It is a development of the 18th-cent. small sword, and in modern times is nearly always used blunted. See also FENCING.

Épernay [āper'nā], French town on the Marne in the department of that name, c. 90 m. E. of Paris. It is the commercial centre of the Champagne wine trade. Minor industries are sugar-refining, brewing, and railway works. Pop. 20,500.

Ephemeroptera, see MAY-FLIES.

Ephesian Artemis, *Thea*, an ancient Oriental goddess adopted by the Greeks. In the temple of Ephesus she is represented with many breasts, the epitome of motherhood. She is identified with Diana, the moon-goddess, and Diana, the huntress, indicating primeval origin. See also ANTIQUOLOGY; PREHISTORIC PERIOD.

Ephesians, *Eplastic* to, a book of the New Testament supposed to have been addressed by St. Paul as a letter to the Church at Ephesus, in Asia Minor. Its teaching lays stress

on the fulfilment of God's purpose in the Church and exhorts Christians to unity

Ephesus ancient city of Asia Minor in classical times a centre of the worship of Artemis (q.v.) whose temple regarded as one of the seven wonders of the world was burned down by the maniac Herostratus on the day Alexander the Great was born Its rebuilding occupied 20 years The city early became a Christian centre and was visited by St Paul

Ephesus, Councils of, see COUNCILS GENERAL

Ephod, part of the dress of Jewish high priests As used in the Old Testament the word is a little obscure and seems to have more than one application

Ephor a magistrate of Sparta Originally mere judges they finally controlled the Government There were five elected annually They shared in judicial functions controlled foreign affairs and acted as mediators between king and people

Ephraim, second son of Joseph and founder of the stronger of the two

THE EPHESIAN ARTEMIS



as mother goddess



as Diana goddess

as moon goddess



of hunting

tribes into which the house of Joseph was divided With his elder brother Manasseh he was adopted by Jacob their grandfather who conferred the blessing of the firstborn upon him and not upon Manasseh Little is known of Ephraim's personal career but the tribe he founded inhabited W and later N Palestine For a long time it remained united to the tribe of Manasseh

Epic, a poetical narrative of heroic achievements It is largely dramatic in character but embraces a greater area and admits many incidents each of which might serve as a dramatic plot and in the epic the personality of the narrator is made much more obvious than is that of the author of a drama There are two main types of epic the popular or national such as the *Iliad* and *Odyssey* or the *videlungenlied* and the literary or artificial such as the *Aeneid* or Ariosto's *Orlando Furioso* or the *Paradise Lost*

Epictetus (fl. c. a.c. 100) Greek philosopher In his youth he was taken as a slave to Rome where he became an adherent of Stoicism He was expelled from Rome by Domitian and spent the rest of his life in Ephesus He wrote nothing but one of his pupils Arrian wrote two treatises *Discourses of Epictetus* and the *Encheiridion* which contain an exposition of his teaching and doctrines He taught that the mind of man is self-contained and self-sufficient enabling him to find complete content in any environment however inimical or oppressive and that the world is governed by the thought of a transcendent God

Epicurus (c. 34-270 B.C.) Greek philosopher who was born in Samos but established his home and opened a school in Athens where he taught women as well as men His philosophical outlook is in the main ethical and directed to finding a way of life that shall ensure quietude of mind and a steadfast faith He taught that nothing can be either created or destroyed and that the

universe consists of matter and space, beyond which nothing can be imagined. The universe is infinite, because it is without extremity, and is composed of an infinite number of atoms.

The chief good of life, according to Epicurus, is pleasure, but the pleasure of philosophical contemplation rather than the pursuit of any purely material satisfaction. Although, as with the common use of the word "epicure," his school became identified in popular thought with an excessive attention to fleshly delights, his outlook seems to have been not less austere than that of most classical thinkers. He laid great emphasis on the necessity for abandoning belief in a future life and in any gods who have concern with human affairs, considering such beliefs the greatest obstacles to happiness. Of his writings, which were voluminous, only fragments remain. A queer trace of his influence is found in the Jewish custom of applying the name *Epikouroi* to unbelievers in general. His teaching is best known to posterity in the detailed and beautiful exposition of Lucretius, *De Rerum Natura*. The Epicurean School survived until the 4th cent. A.D. See also PHILOSOPHY, ANCIENT.

Epidemic, a disease which affects a large number of people in a particular locality at one time. As a rule it is infectious from person to person, but it may affect its victims independently. In the Middle Ages, when there was little sanitation, epidemics were frequent, and were regarded as inevitable. During the 18th and 19th cents., however, it was recognised that diseases were transmitted from one person to another by some agent, which was later found in most cases to be a bacillus or similar micro-organism. Epidemics are distributed by various agencies, such as the pollution of drinking water by sewage—causing cholera and typhoid fever, or the bite of a louse or rat-flea—conveying respectively typhus fever and plague. Influenza, scarlet fever, and smallpox

are probably transmitted through the air.

Some epidemics seem to be seasonal. Typhoid fever, scarlatina, and diphtheria are most prevalent in the autumn, whooping cough in the spring, and measles twice a year, in mid-summer and Dec. Infantile diarrhoea regularly occurs from June to Sept., reaching a maximum in July. These seasonal occurrences are dependent to some extent on sunshine, rainfall, and temperature. The severity of epidemics also rises and falls over a certain period of years, but sometimes extensive epidemics may break out for no apparent reason.

The prevention and treatment of epidemics vary with the nature of the outbreak. Usually compulsory notification of cases is desirable, followed by isolation, but this is only possible when the numbers are not too great to cope with. It would be impossible in outbreaks of influenza. Attention must be paid to the purity of food and drinking water, rubbish must be removed, and hygienic conditions generally instituted.

Epidioscope, see OPTICAL INSTRUMENTS.

Epigram, literally, and originally in Greek, "an inscription" of a few lines suitable for an altar, tomb, monument, etc. By reason of its brevity it had to be neat, to the point, and pithy; hence it developed that sting in its tail which later became its salient characteristic. The French and English epigrammatists have all used as their model that master of this form in Latin, Martial (*q v*).

Epigraphy, the study of ancient inscriptions incised on some hard material such as stone or metal, distinguished from palæography, which is the study of ancient manuscripts written on papyrus, parchment, or similar material. Epigraphy embraces the examination of *graffiti*, or casual scrawls on statues, walls of buildings, but writings on sherds of pottery or on wax tablets are more properly considered as belonging to the manuscript

class. Inscriptions on coins belong to the science of numismatics (*q v*)

The materials used include marble, stone, bronze and clay. In the case of clay (*e g* a Greek vase) the inscription was painted or incised before the object was fired, or incised after firing. The lettering (*see* ALPHABET) included hieroglyphs, cuneiform characters and alphabetic writing. The date of an inscription may often be ascertained from the style of the lettering or from the kind of alphabet used.

Inscriptions are of two main kinds—those which depend on and explain a sculpture, painting or structure (such as a tomb) and independent inscriptions conveying direct information. Before the invention of printing the second class of inscriptions was of great importance in the life of a community as they often conveyed information which to-day would be provided by a newspaper, poster or book. Even to-day both classes exist. We see the first class in the lettering at the base of a statue or picture or on a tombstone; to the second class belong such notices as: Please cross here. Trespassers will be prosecuted.

No smoking

Inscriptions are as old as writing. Some Egyptian and Mesopotamian examples belong to the 4th millenium *B.C.* In the case of early civilisations they must be taken in connection with the archaeological remains themselves as our main source of information that is provided they can be deciphered. The discovery in the Rosetta Stone (*q v*) of a decree in three languages (Egyptian hieroglyphs, hieratic script and Greek) provided a key to the decipherment of Egyptian writing. The work of Sir Henry Rawlinson in deciphering the trilingual cuneiform inscription at Behistun in Persia, opened the door to the study of Assyriology. Even when written histories of a civilisation exist as in the case of Ancient Greece provide us

with an enormous amount of supplementary information. Thus Greek and Latin inscriptions give details of the administration and ritual of the temple, laws and regulations, decrees of the people, magistrates and emperors, public accounts, military documents, treaties etc. Some historical records such as the Monumentum Ancyranum (an autobiographical account of the administration of Augustus) are of great importance. The countless inscriptions on tombstones afford some interesting statistical information. The same may be said of milestone and boundary stones. As is the case to-day, sculptors often signed their work.

The reading of ancient inscriptions, even where the language is familiar, is a matter for the expert. Quite apart from the fact that portions of the inscription may have been broken off and the missing portions have to be conjectured, the lettering itself may present considerable difficulty owing to the taste for abbreviations which developed into a passion in Roman times. But the study of inscriptions is indispensable to the student of history. Except in such cases as epitaphs they provide plain, unbiased facts and even the epitaphs do not exaggerate very much. The most important of written histories must be a mixture of facts and opinion, and an astute historian can convey almost any desired impression merely by the way he marshals his facts.

Epilepsy (or *Falling Sickness*) a nervous disorder characterised by sudden loss of consciousness accompanied by convulsions. There are two recognised forms—*petit mal*, the milder in which convulsions are absent and *grand mal*, the more serious form in which the typical convulsive fits occur. There is also a further type known as Jacksonian epilepsy in which only certain muscles are affected and consciousness is not lost. The symptoms, however, approach those of *grand mal*. Jacksonian epilepsy is regarded as dis-

tinnet from true epilepsy, and due to some definite irritation of the brain, but the fundamental cause of real epilepsy is not known, though alcoholism, fright, injuries to the brain, and certain illnesses are predisposing towards it, and heredity has a distinct influence. It is generally transmitted as some other form of neurosis, which may recur in the form of epilepsy in any future generation. It most often manifests itself between the ages of 10 and 20 and again at about the age of 40.

In *petit mal* the patient may be unconscious for only a few seconds, he may suddenly break off a conversation, stare fixedly in front of him, and then resume talking as though nothing had happened, or he may make some sudden movement. *Petit mal* may be associated with *grand mal*, either preceding or following it. In *grand mal*, before the onset of the fit the patient may have certain warning sensations, such as tingling of the skin, flashes of light before the eyes, pain in the stomach, or noises in the ears, and he may have time to get to a place of safety. The beginning of the fit is usually marked by a loud cry, due to convulsive action of the muscles of the larynx, and the patient falls to the ground. The muscles are stiffened, the jaws clenched, and the face livid from stoppage of the breathing. In about half a minute violent convulsions ensue, the arms and legs are jerked about, and the tongue may be badly bitten. The pulse is rapid and the pupils of the eyes dilated. After a few minutes recovery begins, but the patient may remain in a state of drowsiness or stupor. In rare cases a succession of fits may follow one another without any intervening recovery of consciousness.

In masked epilepsy the fits take the form of attacks of delirium, or furious outbursts during which the patient may commit suicide or do some act of violence. Loss of memory is probably a kind of epilepsy.

While the fit is in progress the

patient should be left lying down with the head and shoulders raised. Tight clothing should be loosened and a piece consisting of a handkerchief rolled round a pencil, closed penknife, or similar object inserted between the back teeth. Cold water may be dashed on the face and chest. When the fit passes off the patient should be encouraged to sleep. Bromides of sodium and potassium are the best drugs for the treatment of epilepsy. They should be given over a long period of time in amounts depending on the particular circumstances. Meanwhile, the patient should lead a quiet life, with some light occupation, eat moderately, and avoid alcohol.

Epilobium (bot.), genus of the family Onagraceæ, having parts in fours, with a long 4-sided, 4-valved, 4-celled capsule containing numerous seeds tufted with down. The rose bay is a tall handsome species with long racemes of rose-coloured flowers, found wild in damp woods, or cultivated in gardens where it will grow luxuriantly on any soil, but will spread rapidly, and is difficult to eradicate. Codlins-and-cream, or the great hairy willow herb, is common by streams and ditches, and well marked by its very downy stems and leaves and creeping roots and handsome rose-coloured flowers. There are a number of other species found in particular habitats, all beautiful and easily recognisable.

Epilogue, a term usually applied in English literature to a speech or short poem addressed to the spectators by one of the actors at the close of a play. It was used more frequently by Ben Jonson than by Shakespeare or the other Elizabethans, and it was a prominent feature of the Restoration drama. See also PROLOGUE.

Epinal (ĀPINĀ'HL), fortress of NE France in department Vosges, which it is the capital. The town is situated on the Moselle, below the Vosges mountains which stretch to the E and is an industrial centre employing the water-power of the

over Textiles and iron ware are the chief products Pop 26 800

Epiphany a Church festival held on Jan 6 originally commemorating the Baptism of our Lord which is still its principal object in the Eastern Church in the West it mainly commemorates the visit of the Three Wise Men to the Infant Jesus

Epiphytes, see AIR PLANTS
Epirus, a mountainous and barren district embracing what is to-day Albania. At one period it covered a far wider area but repeated incursions of foreign hordes and changes of dominion left it eventually an ambiguous territory with little agriculture and no industry though it rears a remarkably hardy breed of cattle Pop. 312 600 For its modern history see ALBANIA

Episcopacy a form of Church government whereby churches are grouped together in dioceses under the authority of a bishop This form is opposed to the local autonomy of Congregationalism and to the Presbyterian system of government by elders There are various types of episcopacy In the Roman Catholic Church the powers of the local bishops are overshadowed by the supremacy of the Pope as universal bishop The main divergence on principles is between those who hold that episcopacy is merely a convenient form of Church government and those who believe it to be a divinely instituted vehicle of grace carried on through the Apostolic Succession This latter view is that of the Orthodox and Catholic churches and of the majority of the Anglican Communion

Epi-taxis, bleeding from the nose In childhood it is frequent and of small significance as a rule but it may be a symptom at any age of a fractured skull congestion of the brain the presence of a tumour or foreign body in the nose ulceration of the nasal mucous membrane or haemophilia (q.v.) It sometimes accompanies enteric fever in and Bright's disease and high blood

pressure In this last case it is salutary It can usually be stopped by applying cold compresses to the nose and nape of the neck or even by holding the nose to allow clotting In severe cases the nostril may have to be plugged

Epitaph, a short composition in either verse or prose nominally for the tomb of a deceased person and generally setting forth his or her virtues and the survivors' regrets Many fine verse examples have been written in English notably by Herrick and Wotton

Epithalamium, a marriage hymn a very ancient literary form In ancient Greece and India it was part of a solemn ritual chanted by the priest but later it became secularised The 18th idyll of Theocritus is a famous epithalamium having the marriage of Menelaus and Helen for its theme other examples in the Classics are the 61st and 72nd Odes of Catullus This form became popular in England in the 16th and 17th cents and was used by Carew Campion Herrick Jonson Shakespeare Sidney Spenser and Suckling In the 19th cent Shelley wrote a fine bridal song

Epsom, market town in Surrey 16 m S.W. of London enjoying a world-wide reputation for its horse-races and mineral spring During Stuart times the spring or well on the Common brought a large number of people to Epsom Racing has been a feature of Epsom life since James I there are two race meetings on the Downs every year—a spring meeting and the summer meeting with the Derby and the Oaks Pop (1931) 27 089

Epsom Salts, the popular name of hydrated magnesium sulphate $MgSO_4 \cdot 7H_2O$ it is used medicinally as a cathartic and also for the weighting of textiles See also MAGNESIUM

Epstein, Jacob (b 1880) sculptor of Polish Jewish descent and born in New York In 1902 he began to study at the École des Beaux Arts in Paris having already received some training in New York In 1905 he came to London and 3 years later was chosen

to do the carvings for the British Medical Association's building in the Strand. His 18 large reliefs caused some sensation. In 1909 he began work on the memorial for the Oscar Wilde tomb in Père Lachaise cemetery, Paris, this was erected in 1912, but such an uproar was made over its alleged indecency that for months it was kept covered by tarpaulins, which from time to time were removed at night by the sculptor's indignant admirers. It is characteristic of Epstein's work that nearly everything he produces, other than his portrait busts, which are widely admired, is violently assailed by certain critics. His *Venus* (1914), his bronze *Christ*, the *Rima* memorial to W. H. Hudson in Hyde Park (1926),



Oriol Ross, a Bronze Bust by Jacob Epstein

less, Epstein's *Maternity* stands in the Tate Gallery, and many people admire his work as whole-heartedly as his detractors abominate it.

Equation of Time, see **TIME**

Equations, Chemical, see **CHEMISTRY**

Equator, see **GEOGRAPHICAL TERMS**

Equerry, an officer in the royal household who acts as personal attendant of the King, Queen, or other member of the Royal Family, especially when riding in State. Equerries are in the department of the Master of the Horse.

Equestrian Order (Rom. hist.)

Romulus was the legendary founder of an order of 300 equites or horsemen, which number increased under his successors until it reached 3000.

Originally each eques received a horse from the State, but at the siege of Veii, 396 B.C., many citizens volunteered to serve with their own horses, thus came into being a new class of equites, receiving money in lieu of horses. The Lex Sempronia of C. Gracchus required all juries to be chosen from the equestrian order, and thus raised the order to immense power in the State. This was repealed by Sulla, but in 70 B.C. it was ordained that juries be elected from senators and equites. Augustus reorganised the order, placing the heir to the throne at its head. It gradually became extinct in consequence of indiscriminate distribution of honours.

Equidae, family of hoofed mammals of the order *Perissodactyla* (q.v.), including the horses, asses, and zebras (qq.v.) See also **EVOLUTION**

Equinox, see **EARTH**

Equisetum, see **HORSETAIL**

Equity, in its most general sense that which, in human transactions, is founded on natural justice, honesty, and right. In the more particular sense which it has acquired in English law, the word means that body of rights and remedies, founded on principles of natural justice, which developed out of the King's prerogative to give relief in cases where the law was too limited, and its procedure too rigid, to do complete justice. From the time of Cardinal Wolsey this prerogative was delegated to the Lord High Chancellor, as Keeper of the King's Conscience, and exercised by him in the Courts of Chancery and Exchequer over which he presided. The equitable jurisdiction of the latter was abolished in 1842, but that of the Court of Chancery remained until the Judicature Act of 1873, which abolished the old Courts, created a new Supreme Court of Judicature, and provided that equitable rights and remedies should be recognised and enforced in all its divisions. Long before that time, of course, the rules of equity had become as well settled as the rules of common law.

Equitable jurisdiction is of three kinds (1) the *exclusive* jurisdiction depended exclusively on equitable principles enforced by equitable remedies and was exercised in matters as to which law gave no rights though conscience required that rights should be given as e.g. in cases of negligence where, at law negligence was not sufficient but fraud must be proved (2) The *concurrent* jurisdiction was exercised where the law sufficiently recognised the right but did not give adequate remedies. Thus at law breach of contract only gave a right to damages but equity could order the defendant to carry out specifically what he had undertaken to do (3) The *auxiliary* jurisdiction existed merely to supply defects of procedure at law where law gave adequate rights and remedies but its machinery to enforce them was defective. Thus if documents essential to prove the plaintiff's case were in the hands of the defendant law was powerless but equity could order discovery of the documents to be made.

The Judicature Act 1873 by fusing the Courts of Law and of Equity has simplified procedure while not altering in the slightest the nature or extent of equitable rights and remedies. All legal and equitable rights and remedies are recognised in all branches of the Supreme Court but whereas formerly in cases involving the auxiliary jurisdiction of equity it was necessary to proceed both in a common law court and in the Court of Chancery in respect of the same matter this is no longer necessary. *See also* TAUST MORTGAGE CONVERSION MISTAKE INJUNCTION SPECIFIC PERFORMANCE etc.

Erasmus, Desiderius (c. 1466-1526), Dutch scholar and humanist son of Roger Gerardus born either at Rotterdam or at Gouda. He became an Augustinian canon at Steyn near Gouda and was ordained priest in 1492. Two years later he went to Paris university where he began his *Colloquia*. He visited England in 1499

meeting Colet at Oxford as well as More and Grocyn. Here he formed his resolve to concentrate on theology. Returning to Paris in 1500 he divided his time between taking in pupils and writing book dedications his first collection of *Adagia* appearing about this time. After another visit to England in 1505 he went to Italy associating with Aldus Manutius at Venice where a new and enlarged edition of his *Adagia* as published at the Aldine Press. In 1509 Erasmus again came to England staying with Sir Thomas More at whose house he wrote the satire *Moriae Encomium*. In 1514 he met the publisher Johann Froben at Basle and after further visits to the Netherlands Germany and England he settled in Basle as Froben's general editor. Froben a press under the guidance of Erasmus soon acquired a European reputation and Erasmus himself became famous as an arbiter of the humanities.



Erasmus.

After Froben's death Erasmus went to Freiburg but returned to Basle in 1535.

Erasmus was unwilling in spite of pressure to be drawn into theological controversies. Adopting an open attitude towards the Reformation he was accused by the Church of favouring Luther and by the Protestants of favouring the Church. His memorable edition of the Greek Testament undermined the credit of the clergy since it showed that the Vulgate hitherto regarded as above criticism was not infallible as a translation.

Erasmus unlike Luther made no popular appeal his voice was heard only by the cultured by whom he was justly regarded as the greatest humanist of his age.

Erastus, Thomas (1514-1583) German Swiss student of medicine and

theology. He was Professor of Medicine at Heidelberg, and he advocated the teaching of Zwingli as opposed to Calvin in 1560. He is best known for a thesis published posthumously, holding that sins should be punished by civil authority, not ecclesiastical. The Erastians, named after him, were so called because they held that the Church should be subservient to the State. In England the name was given to certain Puritans in the time of Charles I, and to the Hanoverian bishops generally.

Erbium For the characteristics of erbium see ELEMENTS

A metal belonging to the group of rare earths (*qv*). It occurs in gadolinite (*qv*) and other minerals, and yields red salts.

Erckmann—Chatrian, French literary collaborators, whose full names were Émile Erckmann (1822-1899) and Alexandre Chatrian (1826-1890). Their joint work includes short stories, novels (e.g. *Madame Thérèse*, 1863, *Waterloo*, 1865, *Le Grandpère Lebigue*, 1886), and plays. Their collaboration lasted from 1847 to 1889.

Erebus [ER'IBŪS], in Greek mythology, a god of Hades, the underworld, son of Chaos and Darkness, husband of Night. The name was also applied to his dwelling-place, a part of Hell, through which all the dead had to pass.

Erebus, an Antarctic volcano situated in Ross Island, off S Victoria Land, in latitude 77° S. It is 12,370 ft high, and has recently been active. With a dormant volcanic peak, Mount Terror, 30 m E of it and 10,000 ft high, Erebus was discovered in 1841 by Captain James Ross, who named them after his ships.

Erechtheion (or *Erechtheum*) An exquisite Greek Ionic temple near the N margin of the Acropolis plateau, Athens. Actually the structure is composed of two temples grouped together with a N and S portico, the small S portico being famous for its Caryatid figure-supports used as columns.

The building, of which the ruins still exist, was begun during a lull

in the Peloponnesian war and not being completed until c 400 B.C. Traces of its original external construction are still visible, but its interior, owing to the many changes it has suffered (at one time it was a Christian church, at another a Turkish harem), is largely a matter of conjecture.

In structure the temple presents a complete departure from the ordinary form of Grecian temples. The usual W portico is missing. The E portico is simple in form, the only exception being the richness of the capital.

On the S, columns are dispensed with, and the roof is supported by six figures of maidens, larger than life size. The roof is flat, a small doorway and a flight of steps leading to the interior of the main temple.

Erfurt [AR'FOORT], town in Saxony,



Erfurt Cathedral and Market Square

Prussia. The Cathedral is a good example of pure Gothic. The town has a variety of industries, from machinery and dyeing to textiles, chemicals, and flower-seeds. Erfurt during the 14th and 15th cents, was a member of the Hanseatic League (*qv*). Pop 141,800.

Erg, see WEIGHTS AND MEASURES.

Ergosterol, a naturally occurring higher alcohol having the probable formula $C_{27}H_{44}OH$. Ergosterol is of great practical and theoretical importance, since on irradiation with ultra-violet light it is changed to a compound which is almost certainly identical with Vitamin D, and which, at all events, has a powerful antirachitic action.

Ergot, a fungoid parasite found on several cereals principally rye. It causes the disease of ergotism which occurs among people who live largely on rye bread. Ergot is widely used in medicine for its power of contracting the pregnant uterus and as a hemostatic to minimise post partum hemorrhage. Ergot is popularly supposed to be a strong abortifacient but it is actually of very little value as such and is never used legitimately.

The active principles of ergot are two alkaloids ergotoxine and ergotamine found on different types of ergot never together so far as is known. They have the same physiological action of contracting the uterus. Ergots also contain tyramine (*p*-hydroxyphenyl-ethylamine) which increases the blood pressure and histamine (β -aminazyl-ethylamine) which also has a physiological action on the uterus. Ergot also contains c. 30 per cent of a fatty oil which has c. 1 per cent of unsaponifiable matter containing appreciable amounts of ergosterol (*g*v) the precursor of Vitamin D. See also ALKALOIDS.

Ericaceae (bot.) a dicotyledonous family of shrubs or small bushy trees with evergreen often rigid opposite or whorled leaves. This well known order contains a large number of beautiful plants many remarkable for their social habit extensive tracts of country such as heaths often being entirely covered with a few species. They are very abundant in S. Africa whence they are often called Cape plants. They are common also in Europe in N. and S. America both within and without the tropics and in the mountainous parts of Asia. The extensive genus *Erica* (heath) contains no plant possessing useful properties except *Erica a. borea* from which briar root pipes are made. Briar is a corruption of its French name *bruyère*. Ling is astringent and sometimes used for dyeing its tough branches are a common material for brooms. Its flowers are favourites with bees and its seeds and young

tender shoots form a large part of the food of moor fowl. The Strawberry Tree (*Arbutus unedo*) belongs to this family also the Azalea, Andromeda and Rhododendron. The leaves of the latter plant possess dangerous narcotic properties.

The Whorlberry and Cranberry which are species of *Vaccinium* are placed by some botanists in this family and by some in a special family *Vacciniaceae* since their



Floral Diagram of *Ericaceae* ovary is beneath the calyx.

Ericson, Leif (c. 1000 A.D.) continued the explorations of his father Eric the Red from Greenland. He is credited with the discovery of Labrador the E. coast of America and Nova Scotia.

Ericsson, John (1803-1889) Swedish American engineer who became a draughtsman to the Swedish Canal Company at the age of 19. He came to London in 1836 and with John Braithwaite designed a locomotive for the Liverpool railway competition of 1839. He made many inventions concerning marine-engines notably the screw propeller 1836 and several forms of armament. He went to America in 1839 and was naturalised in 1843. He built many iron ships and in the Civil War designed armoured warships for the Northern States.

Erie city in Pennsylvania U.S.A. on Lake Erie. It is an important lake port and industrial centre and has an excellent harbour. There is a considerable trade in coal and iron ore and Canadian exports. The principal industries are the manufacture of machinery ironware and asbestos products. The city has a municipal air port. In 1813 the Americans won a

naval battle over the British on the neighbouring lake waters Pop (1930) 116,000

Erie Canal, in the U.S.A., connects Lake Erie with the Hudson R. It was completed in 1825. It is at present navigable for shallow-draught vessels only. Its length is c. 340 m.

Erie, Lake, one of the great lakes between S.E. Canada and the U.S.A., ranking fourth in size. It is situated between Lakes Huron and Ontario and is connected with the former by the navigable St. Clair R. and with the latter by the Welland Canal. The lake is an important centre of inland navigation, having the industrial town of Pittsburgh on the S., whilst Canadian cereals are largely transported E. from the prairie region along its waters. Erie is shallow, covered by ice in winter, and subject to violent storms. It is c. 10,000 sq. m. in area.

Eriu, old name for Ireland, of unknown origin. There are many theories to account for it, one deriving it from an older form Iverio, and this seems to be borne out by the fact that the Latin name for the country was Ibcrio or Hibernia, the former being found in the Confession of St. Patrick, an early Irish MS. The Norsemen called the country the land of the Eire, from which the present word *Ireland* is derived.

Erinna (fl. 600 B.C.), Greek poetess, possibly a friend of Sappho. Of her poems, which seem to have been very highly esteemed, mere fragments exist, her best-known poem is represented by 4 lines only.

Erinyes, Greek name for the Furies (qv).

Eritrea [pron. Ā-RE-TRĀ'Ā] (*Italian Somaliland*), Italian colony along the W. shores of the Red Sea, extending considerably inland in the N. It is bounded N. and W. by the Sudan, S. by Abyssinia and French Somaliland, and E. by the Red Sea. Off Massawa, the chief port, is a group of islands, the Dahlak archipelago. Much of the coast is coral-fringed.

The colony is divided naturally into two parts. In the N. is a region of high plateau and hills, an extension of the Abyssinian plateau, while in the S. is a low tract of country with an unimportant group of hills in the centre. The rivers, none of which is navigable, include the Baraka, Sciti, Mareb, and Anseba. The climate in the lower region is hot and humid, but is cooler on the plateau. Rainfall is reasonably plentiful, except in the N.E. desert region. The principal occupation is agriculture, carried on chiefly in the plateau region, where cereals, coffee, beans, and tobacco are cultivated. Cotton has been introduced by the Italians with increasing success. Large flocks of sheep, cattle, and camels are raised, chiefly by the nomadic section of the natives.

Industries are unimportant, though the Italians have established a few cotton-mills. Imports, mainly manufactured goods and foodstuffs, exceed exports—hides, coffee, mother-of-pearl, and a little gold. The N. natives are mainly of Arab stock, and Abyssinians, and towards the S. are of various negro tribes. Chief towns are Asmara (capital), Agordat, and Cheren, and the port Massawa. The area is 46,000 sq. m., and the pop. 622,000 (4000 Europeans).

Erivan, an administrative district of the Armenian S.S.R., noted for its vineyards and fruit orchards. The capital bears the same name, it is situated c. 100 m. S. of Tiflis, is the seat of an Armenian bishopric, and contains the remains of an old palace of the Persian viceroys, as well as an Armenian National Museum, University, and Institute of Music. Its industries include machinery, wine and brandy, bricks, leather, and furniture. It includes an old Persian and a modern Russian quarter, and a magnificent Blue Mosque. Pop. (1926) 62,180, mostly Armenians, Persians, and Tartars, with some Russians and Greeks.

Erl-king (Ger. *Erlkönig*), German mythical king of the elves. The word is the result of a mistranslation from the

Danish and should be *elbhönig*. He is an evil spirit and is best known in Schubert's setting of Goethe's ballad on the subject.

Ermine, a name for the stoat (*g v*) in the white dress which it assumes in winter in cold countries. As a fur trimme with the black tail tips of the animal preserved was formerly highly prized but is now less fashionable.

Ernest Augustus (1771-1851) King of Hanover and Duke of Cumberland. 5th son of George III of England. Commanded the Hanoverian army against the French 1793-5 and again 1810-14. He took an active part in British politics opposing Catholic emancipation and the Reform Bill of 1832. Ernest established absolute rule on becoming King of Hanover in 1837.

Eros [*ε ρος*] Greek name for the god of love the Latin Cupid (*g v*). The well known Shaftesbury Memorial Fountain in Piccadilly Circus, London is surmounted by a figure of him by Sir Alfred Gilbert.

Erosion, *see* DENUDATION.

Erratics, rocks transported by the action of ice during the Quaternary Glacial Period often for considerable distances. They help in determining the extent of the ice-sheets and the direction of their movement. Rocks



Erratic Yorkshire Moors near Ingleborough. from Scandinavia are found in the boulder clay of the E. counties of England and fragments of Shap granite from Westmorland have been found in the Vale of York having been transported over the Pennine chain of mountains.

Erse, a variant of the word Irish.

is a designation given to the ancient Celtic languages of the Scottish Highlands and Ireland but more usually confined to that of Ireland. It has had a great and largely artificial revival since S. Ireland became a self governing dominion. *See also* CELTIC LANGUAGES.

Erskine, John (1695-1768) Scottish lawyer. After 18 years practice at law he became Professor of Scots Law at Edinburgh University in 1737. He wrote *Principles of the Law of Scotland* and a great work *Institutes of the Law of Scotland*.

Erskine, Thomas Erskine 1st Baron (1750-1823) British lawyer third son of the 10th Earl of Buchan. He entered the Navy in 1764 but 4 years later transferred to the Army. After a year or two he abandoned this also and entered the legal profession being called to the Bar in 1778. He was at once successful and acted as counsel for Lord George Gordon in 1781. He was M.P. for Portsmouth 1783-84 and again 1790-1806 but was not a success in Parliament. He had become a K.C. in 1783 and later Attorney General and Chancellor to the Prince of Wales but temporarily lost favour by defending Thomas Paine. He recovered popularity and became Lord Chancellor in 1806 when he was made a peer.

Erysipelas, a contagious disease due to the invasion of the tissues by the streptococcus germ producing fever and a local redness of the skin. It often attacks a wound and frequently appears on the face here there has been no obvious injury. Some people are attacked at least once a year thus there is no immunity resulting from one attack but rather the reverse. The inflammation of the skin may spread to deeper tissues producing wide spread necrosis and the general symptoms may also become very severe the fever increasing and pneumonia nephritis or meningitis coming as complications.

Erythremia, *see* BLOOD.

Erzberger (from *Erzberg*) Matthias (1875-1901) German politician en

tered the Reichstag in 1903. He became leader of the Centre or Catholic Party, negotiated for peace with the Allies in 1917, and was chief German delegate on the Armistice commission. He was appointed Finance Minister in the Republican Government of 1919, but was accused of corruption, and later assassinated by his political enemies.

Erzerum [ERDZ-ROOM'] (1) vilayet in Asiatic Turkey. Formerly part of Armenia, it is mainly concerned with the cultivation of timber and cereals and mining. There are a number of salt and sulphur springs. Area, 10,170 sq m, pop 271,000. (2) Capital of (1). Apart from its uses as a depot for goods passing between Persia and Europe, some trade is done in horse-shoes and articles in brass. Pop 30,850.

Erzingan, old town in Turkish Armenia, an important market for cattle and agricultural produce. It is an outpost of the fortress of Erzerum, in the W upper glen of the Euphrates. The town is subject to violent earthquakes. There is a celebrated Armenian monastery near the town. Its occupation by the Russians in 1916 was preliminary to the investment of Erzerum. Pop c 50,000.

Escalator, a moving stairway used to transport passengers between two different levels, such as different floors of a building or the streets and the platforms of an underground railway.

The first escalator was designed and patented by an American named Seeburger. It was subsequently developed by the Otis Elevator Company in the U.S.A. and by Waygood-Otis Ltd in the British Isles. The first escalator publicly shown was the one exhibited at the Paris Exhibition in 1900, and it is still in use.

In many of the London Underground stations escalators have been installed in place of the lifts formerly used, but lifts are retained where the depth of the railway is too great for the economical installation of escalators.

The escalator has the following advantages over the lift

(1) It provides greater rapidity and freedom of movement of passengers. No time is wasted in waiting for lifts or in filling or emptying them, the even flow of passengers tending to prevent congestion of the stations and of the surrounding streets.

(2) It operates continuously in the same direction, and where more than two adjacent escalators are installed, all but one can be set to run in the direction of maximum traffic.

(3) Being entirely automatic, no



Escalator, Waterloo Station

attendants are required—a considerable saving in running expenses.

(4) The power consumption per passenger carried is much less for an escalator than for a lift, because starting and stopping are eliminated and the overall efficiency is higher.

Standard types of escalators are from 2 to 4 ft wide, and will carry from 4000 to 8000 passengers in an hour. A 4-ft escalator run at an increased speed will carry 16,000 persons per hour. As used on the London Underground Railways one pair of escalators (one up and one down) is equivalent in carrying capacity

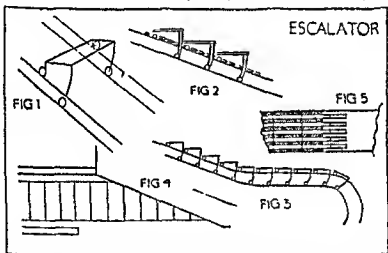
to five of the lifts previously used. The principle of operation of the escalator is as follows:

Imagine two pairs of parallel rails fixed on an incline, the upper rails of each pair being slightly farther apart than the lower rails of each pair (see Fig 1). Now imagine a small table with a wheel at the bottom of each leg, the front legs being longer than the back legs, the length of the table being approximately equal to the distance between the pairs of rails and the wheels on one side of the table being

result is an elementary escalator (Fig 2).

To prepare passengers for getting on and off the escalator is arranged so that the steps flatten out at top and bottom. That is done by suitably bending the rails (see Fig 3).

All the tables, each of which forms one step when on the slope, are attached to the endless driving chains which pass over large sprockets at top and bottom of the slope. An electric motor drives the upper sprockets through worm reduction gearing. As



slightly farther apart than the wheels on the other side. The length of the table is such that if it is placed with its long sides spanning the rails, one wheel will just rest on each rail. The long legs are just long enough to make the table top horizontal. A number of similar wheel and tables placed on the rails as close together as possible will form a stairway, the treads of which will be formed by the tops of the tables. Now if every table unit is attached to chains running between the rails, when the chains are moved the whole stairway is moved. The

sections pass over the top or bottom of the escalator they turn upside-down and still running on rails reach the other end of the escalator where they turn right side up again.

Most of the escalators now in use belong either to the flat-step type or to the cleat-step type. The flat-step type is now obsolete, but there are still several of this type in use. It has smooth treads and at whichever landing the passenger normally arrives at—that is, at the upper landing of an ascending escalator and at the lower

of-arms Sons of peers and knights, and their sons, officers in the forces and members of the Bar are legally entitled to be named Esquire, which title is, however, greatly extended in common usage

Essad Pasha (1863-1920), Albanian leader He fought for the Turks against the Serbians in 1912, becoming President and War Minister when Prince Wilhelm of Wied was made ruler of an independent Albania in 1914 He supplanted him the same year, and during the World War assisted the Serbians against Austria He re-established Albanian independence in 1920, expelling the Italian government, but shortly afterwards was assassinated in Paris

Essay, a literary term originally applied to a draft or rough copy, and hence, by the modesty of the author, to an unpretentious but complete composition It is now used to mean a prose composition of moderate length, limited in range to a single subject The evolution of this meaning is due to the influence of Montaigne (*qv*), who is with justice considered the father of the modern Essay

Essek, see MURSA

Essen, town in the Rhineland, Prussia, a great rail centre, connecting with all the chief centres of Westphalian iron and coal deposits The great Krupp iron and steel works, upon which Essen largely depends, manufactures heavy locomotives, agricultural machinery and implements, and electrical machinery Before and during the World War it produced heavy siege-guns Other manufactures of Essen are textiles and cash registers The Münsterkirche is one of the oldest churches in Germany, and was consecrated in 873 Essen was evacuated by the French in 1925, having been an occupied territory since the Armistice Pop 648,630

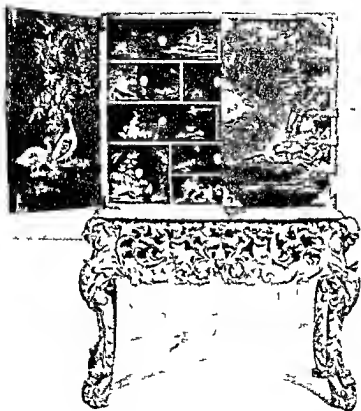
Essenes, a Jewish religious body of monastic habits of life, arising in the 2nd cent BC They combined strict Hebraism with asceticism, and were thus marked off from

the rest of the Jews. They lived a communal life, offered no sacrifices in the ordinary sense, but partook of their midday meal as of a sacrament Some have held that Jesus was brought up among the Essenes, and that Christianity was influenced by Essenism

Essential Oils, *etheral oils*, or *volatile oils*, a group of naturally occurring pleasant-smelling liquids of vegetable origin They must be distinguished from other compounds termed "oil," such as the mineral oils (see PETROLEUM) and the fatty oils (see OILS, FATS, AND WAXES) Apart from chemical differences in constitution, the essential oils differ from the mineral and fatty oils in that they are volatile in steam, and it is by this method they are usually extracted from their sources Chemically, they are principally a mixture of hydrocarbons, alcohols, and aldehydes, with small amounts of such substances as esters, ketones, and compounds containing nitrogen and sulphur.

The usual method of obtaining essential oils is by the steam distillation of the vegetable matter in which they are contained Other methods are extraction by volatile solvents and, especially in the case of volatile oils found in the rinds of citrus fruits, by expression The essences of flowers, used in perfumes, are often absorbed into cold animal fats or a hot oil, the richly perfumed fat or oil then being used in perfumery (*qv*). These latter methods are practised particularly in the S of France, the chief seat of the manufacture of floral essences, with the town of Grasse as centre of the perfume industry.

The main uses are in the manufacture of perfumes and flavouring essences, some also find a use in medicine, as chenopodium (wormseed) oil used in treating hookworm, and oil of juniper, employed as a diuretic As a general rule the principal pharmacological action of essential oils, when taken internally, is a stimulation of the gastro-intestinal tract, the heart, the bronchial membranes, and the kidneys.



ENGLISH FURNITURE
CHARLES II LACQUER CABINET ON GILT WOOD STAND

of-arms Sons of peers and knights, and their sons, officers in the forces and members of the Bar are legally entitled to be named Esquire, which title is, however, greatly extended in common usage

Essad Pasha (1863-1920), Albanian leader He fought for the Turks against the Serbians in 1912, becoming President and War Minister when Prince Wilhelm of Wied was made ruler of an independent Albania in 1914 He supplanted him the same year, and during the World War assisted the Serbians against Austria He re-established Albanian independence in 1920, expelling the Italian government, but shortly afterwards was assassinated in Paris

Essay, a literary term originally applied to a draft or rough copy, and hence, by the modesty of the author, to an unpretentious but complete composition It is now used to mean a prose composition of moderate length, limited in range to a single subject The evolution of this meaning is due to the influence of Montaigne (*qv*), who is with justice considered the father of the modern Essay

Essek, see MURSA

Essen, town in the Rhineland, Prussia, a great rail centre, connecting with all the chief centres of Westphalian iron and coal deposits The great Krupp iron and steel works, upon which Essen largely depends, manufactures heavy locomotives, agricultural machinery and implements, and electrical machinery Before and during the World War it produced heavy siege-guns Other manufactures of Essen are textiles and cash registers The Munsterkirche is one of the oldest churches in Germany, and was consecrated in 873 Essen was evacuated by the French in 1925, having been an occupied territory since the Armistice Pop 648,530

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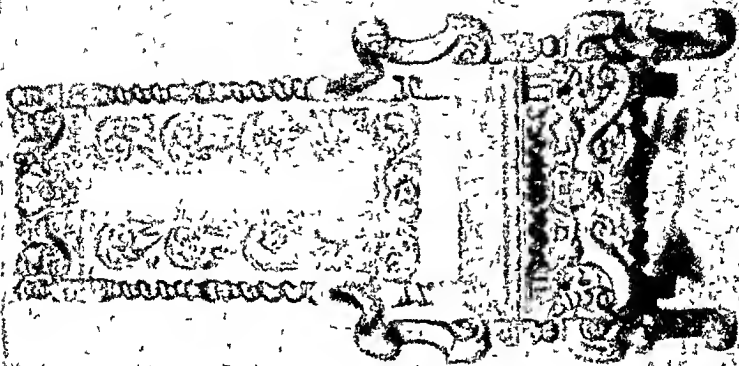
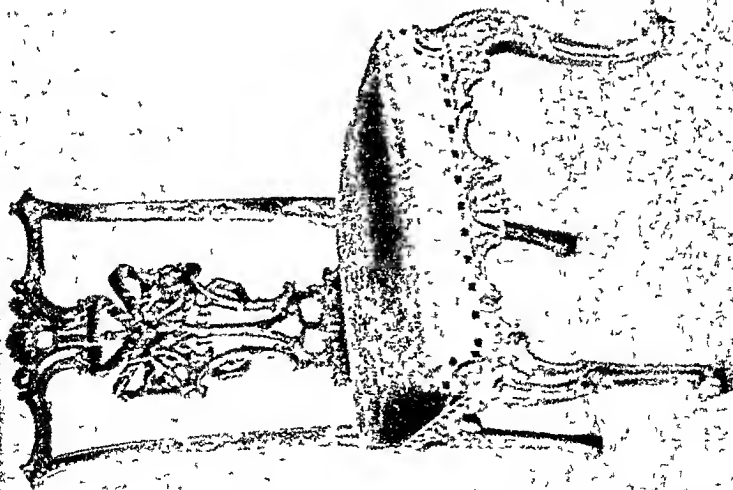
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ENGLISH FURNITURE
CHARLES II LACQUER CABINET ON GILT WOOD STAND



FURNITURE. (1) CHIPPEWDALE RIBAND BACK CHAIR.

(2) WILLIAM AND MARY WALNUT ARMCHAIR. 1934

When applied externally some have a stimulant action on the skin causing flushing and in some cases vesication. Turpentine is an important essential oil and is used in paint.

BIBLIOGRAPHY *The Chemistry of the Essential Oils* by E. J. Parry (London 1906)

Essex, county of S E England bounded to the N by Suffolk S by London and the Thames E by the North Sea and W by Middlesex and Hertford. The coast has large and irregular indentations and much of it is low and marshy. The whole county



A Street in Thaxted, Essex.

is undulating or flat, the higher portion being an extension of the Chiltern system which fringes the N W border but even this does not rise above c 250 ft. The chief rivers are the Stour Colne Blackwater Lea and Crouch. The estuary and N bank of the Thames forms the entire S border.

Essex is an important agricultural county and produces wheat barley vegetables and some hops. Along the Thames side there are important engineering shipping and chemical industries and the docks at Tilbury and East and West Ham are important extensions of the port of London. In

some of the country towns agricultural implements and machinery are manufactured. Large parts of the county were at one time covered by great forests but of these Epping Forest is the only outstanding reminder.

There are several popular watering places on the E coast notably Clacton Southend Harwich Frinton and Burnham-on-Crouch. Other towns are Chelmsford the county town Barking Dagenham Colchester Leyton Ilford Walthamstow and parts of Greater London including West and East Ham. There are a number of interesting churches and ruins in Essex but none of primary interest except important Roman remains at Colchester and the early portions of Waltham Abbey and Thaxted Church. The area of the county is 1540 sq m and the pop (1931) 1 755 240.

Essex, Earls of. Geoffrey de Mandeville became 1st Earl of Essex c 1140. The title was later held by the Bohuns from c 1335 to 1373 by the Bourchiers from 1461 to 1534 by Thomas Cromwell in 1540 by William Parr 1543-53. In 1572 the title was re-created for Walter Devereux who attempted to colonise Ulster and was appointed Earl Marshal of Ireland. His son Robert 2nd Earl (1568-1601) a favourite of Queen Elizabeth served in expeditions to Portugal Normandy and the Azores and was made Earl Marshal of England in 1597. He failed as Lord Deputy of Ireland plotted against the Queen and was executed. His son Robert 3rd Earl (c 1591-1646) fought for Charles I against the Scottish Covenanters but later joined the Parliamentary army and captured Reading but was forced to surrender in Cornwall. On his death the title became extinct. Arthur Capel created Earl in 1661 was envoy for Charles II to Denmark and was Lord Lieutenant of Ireland 1671-7. He objected to James's accession and after the Rye House Plot was imprisoned in the Tower where he was found dead probably by

The earldom has descended in his line to the present (8th) Earl, ALGERNON GEORGE DE VERE CAPEL, b 1881

Essling, see ASPERN

Esslingen, a town in Württemberg, Germany. The surrounding district is fertile. The staple industries are railway rolling-stock, machinery for electrical plant, cloth-mills, and a variety of metal goods. Its wine trade is large, its cellarage is unique, not merely for its age, but its ability to retain the wine of the district at the correct temperature. There are two old churches and a Rathaus, the archives of which contain a considerable amount of valuable data relating to the Reformation. Pop 41,000

Estate: (1) A portion of land in the possession of a single person or corporation, frequently to include the sum-total of an individual's property. (2) In English law, the amount of interest in land owned by a person. The doctrine arose out of the feudal doctrine of *tenure* (*q v*), i.e. that no tenant could have the full ownership of land. Estates may be classified. Firstly, according to the *quantity of interest* of the holder, the right of possession might subsist for an uncertain period during his own life or that of another, or might be unlimited, or limited to a certain number of years, months, or days. The primary division of estates is therefore into such as are *freehold* and such as are less than freehold.

Freehold estates were limited for an uncertain time and were sub-divided into freeholds of *inheritance*, and freeholds *not of inheritance*. The former, on the death of the tenant, would devolve upon his successors, either to all the heirs, collateral as well as lineal, in which case the estate was a *fee simple*, or only to lineal heirs, when it was called a *fee tail*. Thus the fee simple was the highest interest that a man could have in land, since it was only after the failure of all his blood-relations that the land reverted to the lord, while the fee tail reverted upon the failure of the particular class of

lineal heirs designated in the original grant. Freeholds not of inheritance consisted of the various classes of life estates, e.g. for his own life, for the life of another, dower (*q v*), etc. Freeholds were the only estates known to the common law, and the technical term for the possession of a freeholder was *seisin*. The distinction between *seisin* and possession is no longer important, but formerly only a man who was seised could bring a real action for the restitution of his land, as distinct from damages for having been ousted. Estates less than freehold are those which will come to an end at a definite time, i.e. leasehold interests, which include tenancies for a fixed number of years, tenancies from year to year, and weekly tenancies. At the end of the 15th cent. the tenant was given a remedy for the specific recovery of his land, but leaseholds were never brought into the class of freehold estates and to this day remain personal property.

Secondly, estates may be classified according to the time of their enjoyment, i.e. the right to possession may exist now or is to arise in the future. Thus, if a fee simple is conveyed to A for life, and then to B in tail, and finally to C in fee simple, B and C both have present interests which they can dispose of or which will descend to their heirs. But the right to possession will not arise until some time in the future. The doctrine of *tenures* was responsible for the evil of feudal dues, the doctrine of estates produced the notion of *seisin* and the rule that there must always be some person seised, he was the tenant of the freehold, and he alone was responsible for the performance of the feudal duties. The rule hampered freedom of disposition, as no freeholder could grant land to A for life and then to B on reaching the age of 21, for if A died before B was 21, the gift to B failed and the land reverted to the lord. Further, so that the lord might know from whom to collect his dues, feudal law insisted that any transfer of the freehold be public, hence wills of land, being

secret were not permitted. The remedy for all these evils was found in the *trust* (*qv*) the trustee became the legal owner but was forced to hold the land for the benefit of any person the former owner chose to designate by will or otherwise and this enabled a far wider range of interest to be created though the interests were modelled upon the legal estates.

In 1925 tenures were abolished and the only legal estates now are the fee simple absolute (*is* unconditional) in possession (*is* in present possession) and tenancy for a term of years absolute. All other interests can now exist only as equitable interests. See also CONVEYANCING REAL PROPERTY and PERSONAL PROPERTY.

Estate Agent, one who acts as an intermediary agent between the owner of property and potential buyers or lessors. He is required to take out a yearly licence unless already in possession of a licence as auctioneer or other recognised agent. He is usually paid by commission.

Estate Duty see DEATH DUTIES.

Este, town in the province of Padua, Italy, of archaeological interest. Till the 8th cent. the Adige flowed close to the town but to-day it is 9 m. distant. From this town the famous house of Este, ancestors of the present English royal family, took its name. The Estes played a large part in Italian history at the Renaissance period and founded the University of Padua. About the 6th cent. B.C. the town was famous for its pottery. Pop. c. 12,000.

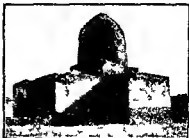
Esters, a group of organic compounds which may be considered the analogues of salts in inorganic chemistry. They are formed by the interaction of acids (either organic or inorganic) and alcohols in a reaction

action or else the water absorbed by dehydrating agent such as sulphuric acid. The ester when prepared can easily be reconstituted into its components by the action of water (hydrolysis). This action however is extremely slow but the addition of an alkali to the water greatly hastens the process. This hydrolysis of esters is of extreme practical importance in the saponification of fats to produce soap (*qv*) since the glycerides (*qv*) of which they are composed are merely a special class of esters.

The majority of esters are pleasant smelling liquids that occur naturally in the essential oils (*qv*) of plants; many of them find uses as flavouring agents and in perfumery.

The principal esters are described under their own headings.

Esther a book in the Bible recording how a Jewess Esther married the



The sepulchral Tomb of Mordecai and Esther in Ecbatana, Persia.

Ahasuerus, king of Persia, was able with the help of her uncle Mordecai to avert a massacre of the exiled Jews.

Eston, an urban district in the N. Riding of Yorkshire near Middlesbrough. Valuable ironstone deposits

Russia, and the Gulf of Finland Area (including Saaremaa, Hiiumaa, and Muhumaa), 18,353 sq m., pop (1932) 1,120,000. About two-thirds of the land is cultivated, principal crops being oats, rye, and barley. Flax growing is increasing. Potato culture is declining through diminishing demand for spirit. Dairy farming and subsidiary interests are increasing, also stock-raising, at the expense of cereals.

Estonia, which is well forested, is building up a good export trade in timber for pit props and sleepers. The paper industry is a feature of the coast up to Russia, and a number of pulping factories are working. The cotton, linen, and woollen industries thrive.



Tallinn

but those associated with metal are less progressive. Main exports are butter, bacon, and flax, and the chief import raw cotton. There are tanneries, match factories, cement works, and oil shale extraction plant. In 1932 the United Kingdom imported Estonian goods valued at £1,257,951, exports to Estonia being £348,772.

Estonia has 99 steamers and 47 sailing-vessels flying her blue, black, and white flag. There are 777 m. of railways, and rapidly extending postal and telegraph systems. Military service is compulsory, the peace strength of the Army in 1931 being 13,535 officers and men. The Navy is small, 19 vessels in all, 2 of which are light.

There is also an Air Force which sits in Tartu by the State

Assembly. There is no State religion but the bulk of Estonians are Lutheran. Elementary education is compulsory, and there are more than 1200 schools. The Tartu University (1632) for men and women is maintained by the State. The Republic is divided into 11 districts. The capital is Tallinn (Reval), (pop (1932) 134,000), the next largest town being Tartu (Dorpat), (pop (1932) 72,000). The language is of the Finno-Ugrian family, with two important dialects, N and S.

In 1920, the Constituent Assembly drew up the existing democratic constitution. The Assembly comprises 100 members, elected for three years by universal secret ballot on proportional representation. A referendum may be taken at any time if 25,000 citizens ask for one. The Prime Minister is the head of the State.

Estonia belonged formerly to Sweden, then (after 1721) to Russia until late in the World War.

Since 1905 she had been struggling for autonomy, and in May, 1918, the claim was recognised by Great Britain, France, and Italy. By the Treaty of Tartu, 1920, Soviet Russia recognised her independence, and in 1921 general recognition was given.

CONSULT *Baltic and Caucasian States*, "The Nations of To-day," Ed. by J. Buchan (1923), *Estonia, Past and Present*, by V. J. O'Hara (1922).

Estoppel, legal rule of evidence aimed at repressing fraud, whereby a person is not allowed to dispute his own statement. See also EVIDENCE.

Estrada, La, town in Galicia, Spain, situated in a hilly district. Maize and wheat are the chief crops, and much stock is reared on the hill-sides. Paper is manufactured on a small scale, and tanneries supply the needs of the growing leather industry. The R. Ulla is used for conveying the logs from the hill forests to the seaports merging on Arosa Bay. The mineral springs have not yet been exploited, Pop c 25,000.

Estreat, the forfeiture of recognisances by a surety for failure to keep conditions e.g. to produce a person a bail

Estremadura (1) The province including Santarem Leiria Setubal and Lisbon in Portugal divided by the Tagus into a N mountainous and a low lying marshy region. Much of the land is uncultivated but wheat, fruit wine and oil are produced in the Tagus valley and salt soda cork and fish are exported. Lisbon and Setubal are the chief towns. Pop. 819 000. (2) Ancient district of W. Spain co-extensive with the provinces of Badajoz and Caceres and consisting of an arid plateau with little vegetation other than scanty pasture supporting sheep and pigs. Figs almonds wine and oil are produced.

Estuary *see* GEOGRAPHICAL TERMS

Estergom [ESTERGOM] (formerly Gran) town on the Danube 36 m from Budapest. Formerly the capital of Hungary it is the residence of the Primate of Hungary. The cathedral with its dome resembling that of St Peter's Rome is in the Italian Renaissance style. The chief industries are cloth weaving and viticulture. There are some good mineral springs in the vicinity. Pop. c. 17 975.

Etab (1) town in the Agra division of the United Provinces British India. Pop. c. 10 500. (2) District of the United Provinces British India having two main trading depôts at Kasganj and Soron. The chief industry is cotton manufacture. Only a part of the district is fertile there are no minerals. Etab came into British hands under the Treaty of Lucknow 1801. Area 1720 sq m. pop. 835 000.

Étapes, [A TAPL] fishing port and watering place on the R. Canche 17 m S of Boulogne frequented by English and American artists who have established a colony there. The main occupation of the inhabitants is boat building and was one of the chief Brit. base depôts

during the World War. There is a great British military cemetery here (10 153 graves). Pop. 6540.

Etawah, chief town of Etawah district United Provinces of India which is rapidly developing into an important trading centre. Cotton weaving is the main industry. A great mosque known as the Jamma Masjid is the principal monument. Pop. 43 000.

Etching the process of biting a drawing or a design on a metal plate by means of acid as distinct from the actual cutting of the lines with a metal tool or steel point as in line-engraving and dry point. *See also* ENGRAVING.

Technique The metal most frequently used for etching is copper. The plate is first coated with a ground which may be prepared in various ways one of the commonest mixtures being of wax and pitch which is applied evenly with a roller to the heated plate or is dissolved in ether and poured over the surface. The ground is then smoked and the etcher makes his drawing with a sharp steel point which cuts through the ground without incising the metal. The back of the plate is protected with a coating of varnish and the whole submerged in a bath of mordant which may consist of nitric acid diluted with potassium chlorate with hydrochloric acid and water or of iron perchloride. The methods of biting vary considerably. The plate may be removed from the mordant when the finest lines are bitten and these covered with varnish or stopped out biting then proceeding as before and the process being repeated until the strongest passages are deep enough. Or a few drops of acid may be poured on to the plate and kept moving so that the depths of the biting of the various lines can be controlled and new lines added as required throughout the process while a method occasionally used is that of making the drawing direct on the submerged plate beginning with the densest passages and ending with the faintest lines.

Frequently the ground is removed

and a proof pulled for examination, the plate being re-grounded and the necessary alterations or additions made. Lines already bitten may be removed with a "scraper" or "burnisher." There are often consequently a number of "states" of an etching, the experimental print, or print made after each biting, constituting separate states.

After biting is complete, the ground is removed, the plate heated and smeared with ink mixed with linseed oil which is worked well into the lines, the residue being wiped off. The printing then takes place in a roller press on dampened paper.

The earliest etchings known date from the first years of the 16th cent. The process of decorating metal surfaces, such as those of armour, by means of etching had been in use for some time, and the idea of printing on to paper designs made in this way was a natural development. In Germany and Holland, Daniel Hopfer, Hans Burgkmair, Dürer, and van Leyden were among the first to use this medium, while Mazzuoli and Schiavone developed the art in Italy. Development was later in France, Spain, and England.

Rembrandt, Tiepolo, Canaletto, Piranesi, Goya, Meryon, and Whistler may be mentioned as the outstanding artists in this medium, which is still very popular to-day, and among the finest contemporary etchers Cameron, Muirhead Bone, Brangwyn, and Pennell occupy a leading position.

CONSULT M. C. Salaman, *The Great Etchers from Rembrandt to Whistler* (London, 1914), S. R. Koehler, *Etching, an Outline of its Technical Processes* (1885), J. Pennell, *Etchers and Etching* (1920).

Eteocles [ÉΤΙΟΚΛΕΣ], a Greek mythological figure, brother of Polynices, with whom he agreed to rule Thebes in alternate years. At the end of his first year of kingship, Eteocles refused to allow his brother to take his place, whereupon the latter formed allies who made the expedition against Eteocles

known as the "Seven Against Thebes" (q.v.).

Ethandune, Battle of (A.D. 878), the West Saxons under King Alfred inflicted a crushing defeat on the Danes under Guthrum. Its site may have been Edington, nr. Westbury, Wilts.

Ethelbert (c. 552-616), King of Kent, received St. Augustine's mission to England in 597, and was the first English king to become a Christian, many of his subjects following his example. Ethelbert built many churches, and instituted the first written Saxon laws, or *dooms*. He is venerated as a saint. Feast, Feb. 25.

Etheldreda, St. (or *Audrey*) (c. 630-679), English saint, Abbess of Ely. About 673 she founded the Abbey of Ely, where she died.

Ethelred, see **ÆTHELRED**.

Ether, the most common of the group of organic compounds known as ethers. Its correct name is ethyl ether, and it is also known as ethyl oxide and as sulphuric ether, the latter from its method of preparation. Ether is a colourless, very volatile, and highly inflammable pleasant-smelling liquid, with a boiling-point of 36°C. and solidifying at -113°C. Ether is prepared in very large quantities by the distillation of ethyl alcohol with strong sulphuric acid. Ether is used for a large number of purposes, it is an excellent solvent, although its high inflammability is a disadvantage in this respect. It is used in surgery as an anæsthetic, and also as a constituent of fuels for high-speed internal-combustion engines. The chemical formula of ether is $(C_2H_5)_2O$.

The ethers as a class may be regarded as the anhydrides of the corresponding alcohols, and are formed by condensing two alcohol molecules together with the removal of one molecule of water.

Etherage, Sir George (c. 1635-1691), English dramatist, wrote several comedies, which equalled in immorality, though perhaps not in wit, most contemporary plays. He was wealthy, and his own morals were not above

The Man of

Vade (1676) is perhaps worthy of special mention

Ethics is the science of moral philosophy concerned not with facts but with values not with the character of but with the ideal of human conduct hence it is not a positive but a normative science. The earliest ethical views hold that there is a supreme good or *summum bonum* and that this is happiness. This view is called *eudemonism*. But other thinkers have declared the *summum bonum* to be not happiness but *perfection* and yet others *duty* or *goodwill*. The idea that happiness is the highest good is based upon the assumption that all man's activities are directed to that and no other end by a route however devious hence popular preaching either points the straight and narrow path to happiness or utters grave warnings against the broad highway that deceives. The question becomes a very vexed one because first the human race may not have a purposeful end secondly presuming that it has that end may not be happiness and thirdly granting an end and allowing that end to be happiness the question arises Whose happiness?

To this question there are three answers

(1) That each individual must seek his own happiness (egoistic eudemonism)

(2) That each individual must seek the happiness of the community of which he is a member or that of the entire race (universalistic eudemonism)

(3) That each individual must strive for the happiness of others and ignore his own (altruistic eudemonism)

Egoistic eudemonism in its crudest form is hedonism in which happiness is found on the physical plane in sensuous enjoyment in a higher form pleasures of the mind the attainment of knowledge the practice and appreciation of the arts etc. are considered the *summum bonum*. In its final form the development of spiritu-

ality it produces the paradox of bodily asceticism to secure the soul's salvation the enduring of self made miseries in this world to secure a blissful existence in the next

Universalistic eudemonism or utilitarianism as it is sometimes called demands that each man must not claim privileges for himself but minister to the wants of the community aiming at the greatest good of the greatest number. There are of course serious difficulties in the path of such an idealism even granting that pleasure varies in quantity only and not in quality it would be difficult to choose between different kinds and to decide how much of each is necessary. If A prefers roast chicken and B prefers music then very little of B's pleasure will be acceptable to A and even less of A's will delight B. Nevertheless the general idea acts as a good incentive to social advance.

Altruism may be criticised on the ground that if the happiness of the individual is of no account the happiness of the community cannot be of greater value for though one and one make two nothing and nothing do not

Perfection as the *summum bonum* means that man must develop his faculties to the greatest possible extent taking the life and works of the admittedly great as a standard upon which to work. The aim of perfection is limited in the same way as the aim of happiness and the expressions *egoistic universalistic* and *altruistic perfectionism* are used. Universalistic perfectionism is the soundest as it is doubtful whether perfection of the individual is possible in an imperfect state. The attempt of most imperfect people to lead their possibly more perfect brethren means that the blind are leading the blind which is some justification for assuming the existence of a superhuman perfection in a spiritual world.

Perfectionism embraces eudemonism in that whatever leads along the road to perfection leads also to happy

ness Both measure conduct by results, good leading to happiness or perfection, evil leading away from it

Duty regarded as the highest pinnacle of virtue stands somewhat in contrast to the two foregoing, because whereas in them the moral value of conduct is measured by results, duty lays emphasis on constraint, on the *Categorical Imperative* of Kant (*qv*), which insists that the right act is in itself necessary and ought to be done, without regard to an end outside itself (for instance, to speak the truth is a categorical imperative). Each man must do only that the doing of which he wishes to become a universal law, evil acts are those in which the individual's own case is regarded as exceptional

Duty and discipline are useful educative factors. Without a sense of the former and a sergeant-major full of the latter, no raw recruit could be converted into a satisfactory soldier, but the entire world would not look well in uniform, even model uniform. Each individual's sentiments are inclined to give a bias to the categorical imperative, and there are many in our midst blissfully unconscious of its voice

Man's knowledge of good and evil is itself variable, depending on time, place, and people; the Jew is told to demand an eye for an eye, the Christian that a soft answer turneth away wrath, but every Jew does not demand *Lex Talionis* any more than every Christian refrains from returning a blow. There are actually three ways of estimating good and evil—empiricism, rationalism, and intuitionism

Empiricism rather suggests that there is no universal moral standard, for it compares the differing outlooks of various people and sees if they "work" in practice.

Rationalism insists upon the power to discern between right and wrong independently of actual experience by the exercise of pure reason, but nevertheless pure reason proves a puny creature divorced from experience.

Intuitionism maintains that there is an absolute moral law of which man is in some mystical way conscious, but intuitionists fail to agree regarding this absolute, some regarding it as moral sense, others as sense perception, others as the product of reason. If intuition is the standard by which we are to set up judgments, then each man is his own norm, and though "conscience makes cowards of us all," A's conscience may remain comfortably dormant, whilst B's conscience is up and doing

Morality is subservient to sanctions, of which three are recognised—religious, political, and social. Religious sanction depends upon the word of God as heard through the Church; but this cannot be regarded as absolute, for if the Church has failed to understand, or understanding, has failed in expressing it, then what are given out as the positive and negative commands of God may easily be reversible, and there is no ethics

Political sanction depends upon the State to decide between a man and his conscience. It tends to confound legality with morality and to sacrifice the religious to the secular. If human happiness depended entirely upon food-inspectors and sanitary inspectors, all would be well, but man insists upon believing that he has a soul to save, and sanitary inspection does not help

Social sanction is tied up in tabu (*qv*). It is at once part of, and greater than, the sum of the foregoing. There may be neither religious nor legal codes to dictate that this or that is reprehensible, but nevertheless it is "not done"—that is enough. A man may be an atheist, an habitual law-breaker, even a criminal, but nevertheless there will be some barrier of tabu beyond which he will not pass. Although respectable society will accept the atheist and law-breaker, or even respect and admire him, closing an indulgent eye, the tabu-breaker is ostracised.

Men's morals in different times and climes do not bear comparison. The

Australian aborigines : ideas of mental relationship differ fundamentally from those of the Roman Catholic yet nevertheless neither has the right to condemn the other as wrong out of hand. Man is the measure of all things, in that all things are measurable only by man's appreciation of them. There is neither standard nor extreme. Good is not the opposite of evil but simply the same thing viewed from an opposite direction. All things are ambivalent : pleasure and pain mingle in a psychological principle and hearty laughter ends in tears. Up and down are directions and vertical implies both.

Egoistic perfectionism is perhaps the only ethical road upon which man may safely set foot for the perfection of self implies all morality, all altruism and all happiness.

CONSTANTIN Wilson and Lowler *Principles of Morals* (1886) J Dewey *Outline of Ethics* (1891) J S Mackenzie *Manual of Ethics* (1913)

Ethiopia, the name applied by the Ancient Greeks to the extensive territories of Africa between the Red Sea and the Atlantic. In 719 B.C. Shabek or Sabaco led an immense army into Egypt where he established an Ethiopian dynasty. More than once Egypt had an Ethiopian king. The official name of the empire of Abyssinia (q.v.) is Ethiopia.

Ethnology or *Éthnographie* deals with the inter-relatedness of the human family not only on the physical plane (physical anthropology q.v.) and in primitive economics, legal codes and social customs (cultural anthropology q.v.) but also in folk-stories, arts, crafts and industries.

The weave of a textile fabric, the finger-point motif in the decorative design of pottery, the carving of wood, building of canoes and working in shell and stone are all covered by the science. Not only the finished product, but the method of working and the tools employed, the sexual distribution of labour and the underlying ideas, whether

in origin, are all matters for close observation and careful registration.

A traditional design may last with out alteration for countless generations, the life of a people being made manifest in their artistic productions and a sign of change is frequently a sign that decadence is setting in. The movement usually from curving lines and bulging contours (curvilinear art) to straight lines and geometrical forms (rectilinear art) in a rich field of archaeological research on a site like Ur of the Chaldees it is possible to read of the rise and fall of city after city by investigating the stratification of refuse heaps with their wealth of broken pottery.

Sexual Distribution of Labour Although the Australian aboriginal maintains that to hunt and fight and to laz about is man's work and all the rest woman's, he does not give tongue to a universal concept. Arts and industries having a special sexual significance, humble domestic and utilitarian matters such as pottery making are usually left in the hands of women who sit with great patience rolling a long cylinder of clay and coiling it into the shape of a vessel, tapping with a flat stone to smooth the surface and baking with hot pebbles, but in the event of a people having learned to use the potter's wheel, the industry is in the hands of men.

House-building worthy of the name is a man's task, though the women in Australia where the dwelling is very primitive are expected to erect the structure of leaves and branches that serves for a home. Canoe building as might be expected is exclusively a male occupation and very often no woman is allowed to witness the activities of the craftsman at work carving the decorated prow boards.

Magic This most important phase of primitive life is officially the property of men. This however does not imply that women never practise magic. On the contrary they very frequently do so, but such practice takes the form of 'Maleficium' it is

secret, and used for harm, though a person who suspects his ill-luck or ill-health to be attributable to witchcraft may visit a rival witch to have the evil spell removed. Official, that is, public, magic, rain-making, and the like take the form known as "imitative" or "sympathetic" magic. The rain-maker, with incantations and spells, pours "medicated" water over hot stones, implying that as this water quenches these stones, so shall the rain quench the parched earth—as clouds of steam arise from these stones, so shall rain-clouds form in the sky. Occasionally, but very rarely, the official tribal rain-maker is a woman.

There are two ways in which magic is transmitted: either by purchase or by inheritance. The secrets are very rarely given, but in societies founded on the matrilineal system, when the maternal uncle occupies the status of the European father, and possessions both of real estate and magic are handed down on the distaff side, a father may, from motives of affection only, give his son some magic. This frequently leads to quarrels in primitive society, for when the nephew comes into his own he finds part already dispensed to a cousin.

The production of articles of adornment from such materials as shell, bone, horn, and minerals like jade (where available) is a matter closely linked up with the magic of personal attractiveness, which is part of love magic and therefore a masculine occupation generally, but in some ethnographic areas, where articles of adornment are not for personal use, but for ceremonial distribution abroad (see KULA), women take part in the work.

Garden magic and garden work are distributed between the sexes, each group having their allotted tasks which they perform exclusively, never encroaching upon each other's rights.

In almost all ethnographic areas cooking is a female occupation, save on ceremonial occasions, when men prepare great quantities of food and give a

feast to some neighbouring friendly tribe.

Folk Tales. Here again we find a remarkable unification of human ideas. All over the world, with the exception of S. America, one form or another of the Magic Flight story is told. The hero fleeing from his enemies is provided with a mill-stone, a comb, and a vessel containing oil or water. These he is instructed to throw behind him when in danger of being overtaken, with the magical result that the mill-stone becomes a mountain, the comb a dense forest, and the oil or water an ocean.

This story is, in its essential theme, an example of the weak by strategy defeating the strong. No people cares for barefaced flight, no stories make a hero of a coward.

All the foregoing examples, to which hundreds if not thousands more might be added, are indicative of the diffusion of the idea-complex from some single source, but no one of them is in itself any undeniable proof of common origin. In some other phases of culture, however, diffusion (see ANTHROPOLOGY, CULTURAL) can be definitely established.

The Double-headed Eagle. In tracing the rise and spread of this familiar emblem of power, we are led back to ancient Egypt, where the sun god Ra was represented in hieroglyphic characters by a plain circle or disc. Horus, the Hawk, was also a member of the theocracy, and to indicate the dual personality, the sun disc was drawn with a long wing on either side, and in later scripts the bird's head was added. The design was copied, c. 2000 B.C., by the Assyrians and the Hittites, between whom, the emblem having less of mystic symbolism and more of decorative value, a second head was added to give balance. The design was carved on cliff faces in Asia, from which it was copied by Turkish potentates c. A.D. 1200, and used by them for coin faces. The money so marked fell into the hands of the Crusaders, and was brought to Europe, where the

heralds seized upon it with avidity. So dashing a design was considered a fit charge for the most noble houses only hence it became the Imperial Symbol in Central Europe. During the reign of Charles V of Spain Cortez and his adventurers conquered the New World and it is from this source that Indian tribes dwelling in the remotest parts of Mexico obtain the device.

The Alphabet The earliest forms of writing are glyphic that is composed of little symbolic pictures that convey ideas rather than words. They are based on the hieroglyphic on names of the gods derived at a very early period in Egypt.

Soon after this or as some authorities assert contemporaneously with it another form of writing came into being in Sumer. This was the Cuneiform a script composed of little wedges placed at angles to each other. The modern Chinese script might be described as cuneiform in character though it partakes to a considerable extent of the rebus or pictographic form. Independent origin is claimed for the cuneiform system but at best it can only be regarded as an advance on the already existing hieroglyphic though no definite connecting links can be shown to exist.

The next decisive step was the introduction of wholly phonetic writing



Trilithon

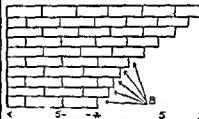
the Phoenicians who carried it to the Greek people.

For the further history of the Alphabet see ALPHABET.

Building—Prehistoric man may conceivably have thrown up rough shelters of leaves or branches similar to the Australian whurly of to-day and in the proto-historic period immensity of structure (pyramids) was but a problem of transport and lifting. Building is interesting from the architectural aspect and the earliest problem was that of roofing.

Pillar and Lintel—Enclosed spaces were first covered on the principle of pillar and lintel or application of the trilion. This method was limited by the sheer weakness of the material—a long block of stone supported at either end being liable to break in the centre from its own weight alone.

Corbelled Arch The next development was the corbelled arch or vault.



Corbelled Arch

This depends on the counterbalance of projecting blocks of stone and absorbs an enormous amount of building material the area spanned necessitating an equal area of solid masonry to support it. It is also inclined to collapse from breakage at the points indicated by the arrows B.

The True Arch The true arch is free-floating and consists of a series of wedge-shaped blocks of stone held in position by the central block or key stone. The first arch is found in an ancient Babylonian brick building situated at Nippur (3000 B.C.). The Assyrians learned the method of construction and used it as a secondary principle. The Etruscans an early Italian people used the arch. It is

The bread or roll is placed on the left hand for ease in crumbling. The pinning of the table-napkin to the waistcoat or dress is deemed, for it suggests inability to convey food to the mouth without spilling, and should this happen, looks unpleasant. Modern etiquette permits or encourages one to begin to eat before the others are served, a less courteous proceeding than of yore. Which knives, forks, or spoons are to be used presents little difficulty, for they are arranged in order of the courses, beginning from the outside. Various rules, with regard to the use of these exist. Briefly, the fork only should be used when no cutting is necessary, such as with minces, for the sweets a fork should be used alone when a spoon is not required, but never a spoon alone. If fish-knives are not available, a fork should be used, in the right hand and a crust in the left. Asparagus may be eaten with the fingers, or the heads

removed with a knife and conveyed to the mouth with a fork. The stones from cherries, plums, etc., are conveyed from the mouth to the plate in the spoon.

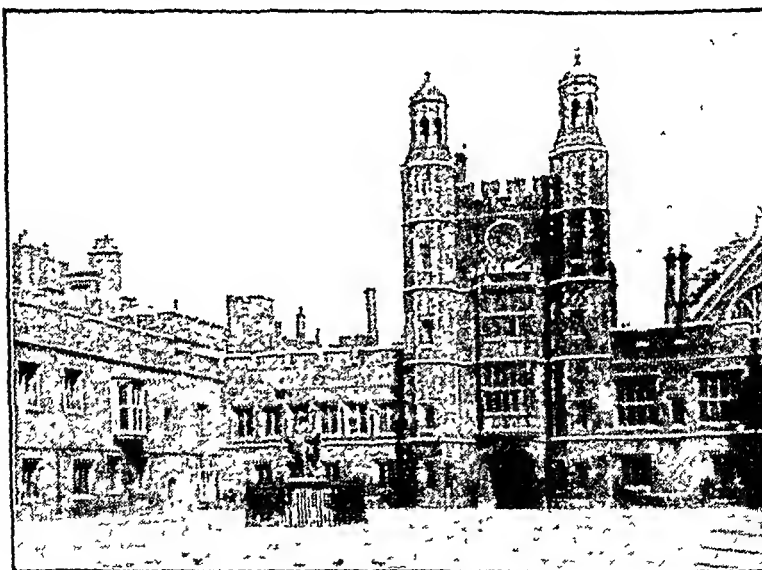
Finger-bowls which are usually placed on the dessert-plate, should be removed to the left with the d'oy, and the fingers dipped in after partaking of dessert.

Wines, which are appropriate to different courses, are given under WINES.

CONSULT *Mrs Beeton's Household Management*, *A Manual of Etiquette*.

Etna, an active volcano near Catania, in E Sicily. The first recorded eruption was in 475 B.C., and is mentioned by Thucydides. On Feb. 1169, Catania was overwhelmed and 15,000 lives lost. Up to Jan. 18 there had been 64 recorded eruptions. The last outbreak of any moment was in 1928. The volcano is c. 10,760 ft high.

Eton College, English public school



Eton College Quadrangle

at Lton Bucks founded by Henry VI In 1443 it was formally opened its first Provost being William Waynflete

Apart from its founder George III was the only monarch who took any active interest in the school and June 4 Eton's annual festival with its speeches fireworks and procession of boats is the date of George III's birthday There are over 90 houses at Eton each with its housemaster and 40 or 50 boys A select number of boys run the internal affairs of the school informally the Eton Society originally founded as a debating society has developed into a social club its meeting place being called Pop It is a great distinction to secure election to Pop

Among the traditions of Eton are two special forms of football the Field Game and the Wall Game

Of the original plan of the founder only the hall remains The fine Gothic chapel resembles to some extent King's College Chapel Cambridge The new buildings extra rooms for the colleges were built in 1846 Many famous names are linked with Eton—Walpole Grenville Fox Chatham Gray Wellington Shelley and Gladstone who never lost his love for the glorious school Among its great Provosts and Head Masters are Waynflete John Rous Lupton Goodall Keate Hawtreay Warre Dr James and Dr Alington Eton is rich in buildings of great interest to the thousands of visitors who annually visit it from America and elsewhere—Lupton's Tower Weston's Yard School Hall Rowland's the Provost's Lodge and Head Master's House

Etruria, ancient part of Italy In early times it probably occupied N Italy between the Alps and the Tiber later it was limited by the Apennines and the Tiber Etruria was at the height of its power in the 7th cent B.C. its inhabitants being warlike and enterprising after this a period of decline set in The people were called Tuscans or Etruscans The Etruscans occupy a prominent place in

the early history of Rome The defeat of their fleet by Hiero I of Syracuse and the great disaster at the Ladisomarian Lake (c 310 B.C.) completely annihilated Etruscan supremacy and with it their independence

Etruscan Architecture, the predecessor of Roman architecture with an Egyptian affinity and helped to link up East and West Scarcely anything remains of the Etruscan temples Architects and builders worked in perishable materials and chiefly concerned themselves with tombs entrance gateways and the walls of towns It was however from the Etruscans that the Romans borrowed the idea of the arch unknown to the Greeks with such important results

Etruscan Language the language spoken by the people of ancient Etruria which corresponds to the modern Tu cany It survives only in inscriptions and has so far baffled all attempts to fix with any real certainty its affinities with other languages It may be composed of an admixture of Italic and Asiatic elements

Etruscans a race inhabiting Etruria in ancient Italy which came originally according to one tradition from Lydia under pressure of famine Another tradition makes them the original inhabitants of Italy but recent archaeological discoveries show that actually they came from the East Their art and religion as well as the direction of their trade point to an Asiatic origin though it is not known whether they came from Lydia or not In Italy they were a powerful race dominating the whole centre of the country but the internal rivalry of their loosely federated cities gave Rome an opportunity of destroying their power though this was not achieved until the close of the 4th cent B.C. after centuries of spasmodic warfare

Ettrick river and hamlet in Selkirkshire Scotland The Ettrick joins the Tweed just over 30 m. from its source James Hogg known as the Ettrick Shepherd is buried in the village an inscription cut by admirers on the

site of his cottage was unveiled in 1898

Etty, William (1787-1819), English painter, born at York. From the age of 11-18 he was apprenticed to a York-shire printing firm. He then came to London, and in 1807 entered the Royal Academy schools, working also under the private tuition of Lawrence. He travelled in Italy and the Netherlands, studying the works of the Italian painters and of Rubens, but was most influenced by the Venetians, trying to reproduce their richness of colour and the physical beauty of their nudes. His work was greatly admired in England, and specimens hang in most of the provincial galleries, as well as in the Victoria and Albert Museum and at the National and Tate Galleries.

Etymology, the science of the origin and relationship of words. Before the study of comparative philology was placed on a scientific basis, many words were incorrectly derived by "popular" etymology, e.g. *surloin* from a hypothetical accolade given to a loin of beef, instead of *surloin* from French *sur* "over, top part" of loin. Most good modern dictionaries give the etymology of every word, but Skeat's *Etymological English Dictionary* remains one of the most authoritative reference books for English etymology. A more modern work is H. C. Wyld's *Universal Dictionary of the English Language* (London, 1932).

Eubœa, large island of Greece, situated in the Ægean sea off the E. coast of Attica and Bœotia. It is c. 90 m. long and 30 m. wide in places, but elsewhere narrows to 4 m. There is a bridge to the mainland over the narrow channel. The surface is mountainous, with fertile valleys, in which graze herds of cattle, the chief occupation of the inhabitants being stock-breeding. Corn is grown in large quantities, and magnesite and lignite are exported. The chief towns are Chalcis and Ertria. It successively belonged to Greece, Rome, Venice, and Turkey, and was restored to Greece in 1830. Area, c. 1550 sq. m., 154,500.

Eucaine [*pron* ū'kân], a synthetic local anæsthetic with a chemical structure similar to that of cocaine.

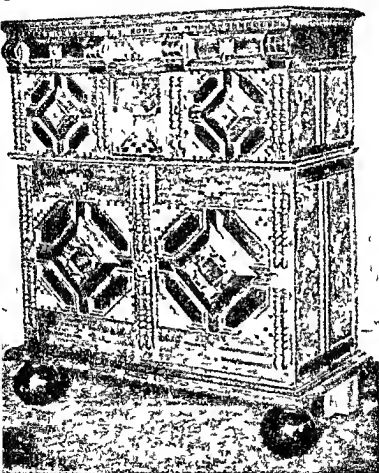
Eucalyptus, genus of trees sometimes called gum trees, originally confined to Australia, but now planted all over the world in tropical and sub-tropical climates. The most important species is *E. marginata* (jarrah), which furnishes a remarkably hard wood used for piles, paving blocks, etc. Eucalyptus oil, which is used medicinally, is produced from distillation of the leaves of *E. globulus* (Blue Gum).

Eucalyptus [*pron* ūkālīp'rus] **Oil**, an essential oil obtained by the distillation of leaves of the eucalyptus tree with water. There are several types of eucalyptus oils on the market, varying with the species of the tree from which they are obtained, the principal varieties of oil being the globulus, dumosa, and amygdalina, corresponding to different types of eucalyptus trees. The chief constituents are terpenes and various higher alcohols and aldehydes. Eucalyptus oil is used in medicine as an antiseptic for wounds. Inhalation of the vapour is employed in treating some respiratory diseases. Industrially the oil is used in making perfumes and soaps, and in ore flotation.

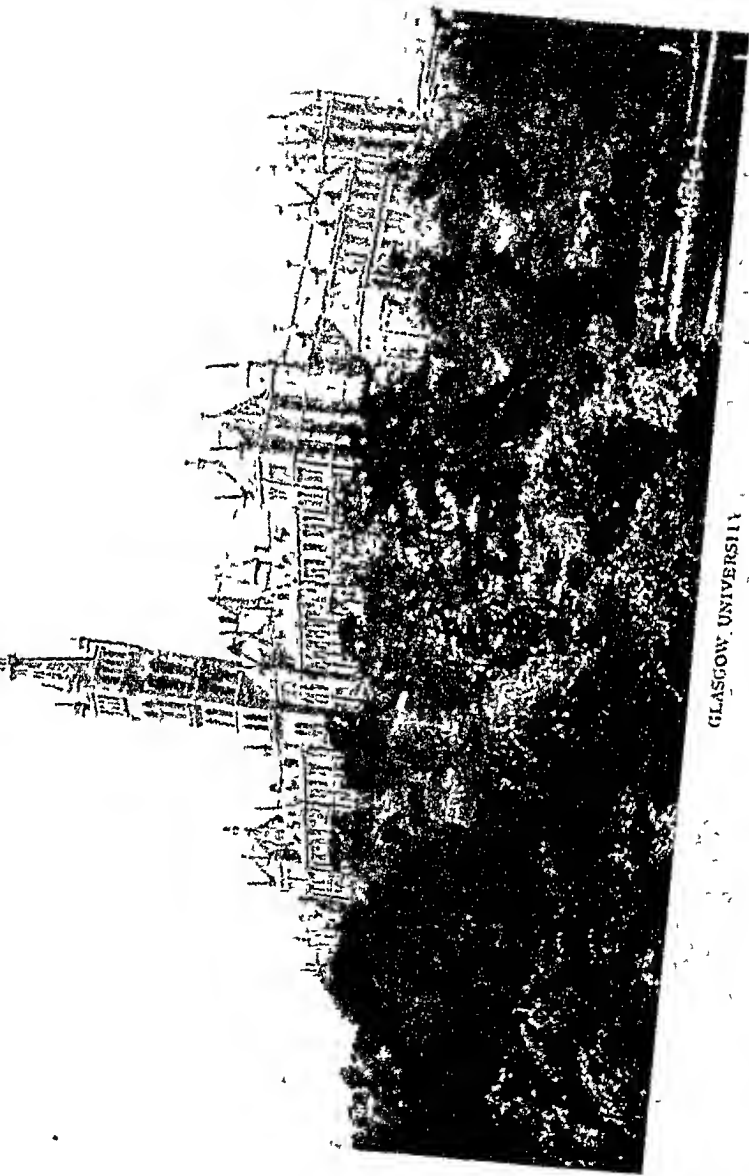
Eucharist, one of the names given to the sacrament of the Mass (*qv*) or Holy Communion. The word, derived from the Greek, means "Thanksgiving".

Euchre [*pron* ū'kre], a card game, usually for 2, 3, or 4 players, played with a "piquet" pack of 32 cards, omitting all below 7, an extra card, or *joker*, is used, it ranks as the highest trump. Apart from the joker, the best card of the trump suit is the *jack*, (*Right Bower*), and next to him ranks the jack of the suit the same colour as trumps (*Left Bower*). The other cards rank normally.

The deal and method of playing the hand are the same as in *Learté* (*qv*), but the trick need not be won, and each player in turn, starting from the dealer's left, has the right either to insist that the turned-up card shall



JACOBEOAN OAK CHEST



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make the trump suit (*order it up*) or to pass. If all including the dealer pass each player in turn has the right either to name a new suit for trumps or to pass again. If all pass a second time the deal is void.

If the turned up card is made trumps the dealer has the privilege of taking it up into his own hand discarding a useless card in its place.

Scoring. If the side or player making trumps win all 6 tricks (a *march*) they score 2 points. If 3 or 4 tricks 1 point. If the trump-makers fail to make 3 tricks they are *euchred* and the opposing side scores 2 points. Game consists of 6 points. A *rubber* consists of 3 games each counting 1 point or 2 points if the loser has not scored at all (a *lurch*).

In *4 handed euchre* any player having made trumps may decide to play a *lone hand*, i.e. make the necessary tricks without the assistance of his partner who lays down his cards. The score for winning all 6 tricks is then 4 points for 3 or 4 tricks 1 point for failure to win 3 tricks opponents score 4 points. The decision to play a lone hand must be announced when the trump is made. In *3 handed (cut-throat) euchre* the trump-maker plays against the other two players who each score * if he is *euchred*. In *railroad euchre* all cards below the 9 are deleted and the *joker* is always used. It is always a 4 handed game.

Eucken, Rudolf Christoph (1846-1908) German philosopher. He studied at Göttingen under Lotze and later at Berlin. Eucken taught philosophy at Basle and held the chair at Jena. In 1908 he was awarded a Nobel Prize. He dealt mainly with ethical and religious problems. He maintained that man is the meeting ground of matter and spirit and that it is his duty to subdue the former by conscious application of the latter. His *Collected Essays* were translated into English in 1914.

Euchid (Eukleides fl. c. 300 B.C.) Greek mathematician. Little is known

of his life except that he taught at Alexandria. He wrote on many subjects but he is best remembered for his *Elements* a treatise on geometry that became the standard work on the science retaining its supremacy almost to the present day. Even to-day his propositions are the basis of all elementary instruction in geometry. Arabic translations appeared in the 9th and 10th cents. and Latin translations in the 11th and 13th. The first English translation is that of Billingsley in 1570.

Eudæmonism, see ETHICS

Eudiometer a chemical apparatus introduced by Priestley (q.v.) consisting of a graduated glass tube with one end closed. By submerging the open end of the tube under water and introducing known volumes of gas the change in volume that occurs in the reaction between two gases can be measured. The first application of the eudiometer was in the estimation of the amount of oxygen in air. The great majority of eudiometers contain platinum wires fused through the glass at the closed end so that an electric spark may be obtained within the tube to initiate the reaction between the contained gases.

Eugène of Savoy Prince (1663-1736) Imperial general. Dislike of Louis XIV. caused him to leave France and serve under the Emperor Leopold against the French and Turks sharing in Marlborough's victories at Blenheim, Oudenarde and Malplaquet. In 1717 he overthrew the Turks and captured Belgrade. Prince Eugène was governor of the Austrian Neth. lands from 1714 to 1724 when he was made Vice-General of Italy. He died at Vienna.

Eugenics, see GENETICS HERE CITY

Eugénie (1806-1870) wife of Napoleon III. Emperor of the French. Daughter of the Spanish Count of Montijo she married Louis Napoleon in 1853 soon after he became Emperor. She was regent during his absences in 1859, 1865 and 1870. After the fall of the empire in 1871 Eugénie with her

husband and son (Prince Louis Napoleon, killed in the Zulu War in 1879), came to England, settling at Chislehurst. After her husband's death (1873) Eugénie removed to Farnborough. She became a close friend of Queen Victoria.

Eulenspiegel [OILENSHPEGÛL], Till (or Tyll), the hero of a German chapbook (16th cent.), in which his practical jokes and scurrilous jests are described. He was a peasant who gulled the townsman, and the stories of him have a satirical tone. The stories were translated into many languages, appearing in England as *The Merye Jestes of a Man called Howleglass* (c. 1528), and under that name ("owlglass" is a literal translation of his surname), he is referred to by Ben Jonson and others.

Euler [ORLER], Leonhard (1707-1783), Swiss mathematician. He is regarded as one of the founders of the modern science. He did important work in algebra, astronomy, hydrodynamics, and optics. He wrote several hundred treatises—many published after his death—when he was totally blind, at St Petersburg (Leningrad), where he had held the Chairs of Physics and Mathematics.

Eumenes, name of two kings of Pergamum, of whom the only one of note was Eumenes II (c. 197-159 B.C.), who assisted the Romans against Antiochus of Syria at Magnesia, and against Perseus of Macedonia. He made Pergamum a centre of great wealth and culture.

Eumenes (c. 361-316 B.C.), Macedonian general, secretary to Philip II of Macedon, and to his son, Alexander the Great. On Alexander's death Eumenes became Governor of Cappadocia, defeated Craterus and Neoptolemus of Armenia, 321, but was slain by Antigonus.

Eumenides [OMEN'IDÉZ], literally "the kindly-disposed", euphemistic Greek name for the Furies (q.v.).

Euonymus, see SPINDLE TREE.

Eupatorium (*Hemp Agrimony*), a genus of the family Compositæ with one British species, a tall, downy plant

3-6 ft. high, with reddish stem, leaves palmately divided into 3-5 elongated leaflets with rough margins, and terminal heads of lilac or rose-coloured flowers, common in moist, shady places and flowering in July and Aug. Several species from N. America are cultivated here, in open and sunny borders, and are propagated by division of roots in Oct. or March.

Euphemism, the practice of alluding to dangerous or unpleasant things by terms which express contrary characteristics or, at any rate, cloak and palliate the objectionable element. Calling the devil "the old gentleman" is an example. The custom must have arisen out of a superstitious fear of offending a malignant deity by calling him by his true name. Thus the Greeks called the Furies the *Eumenides* ("kindly ladies") and the boisterous and dangerous Black Sea the *Euxine* ("hospitable") Sea.

Euphonium, a musical instrument of the saxhorn family, the bass saxhorn in B flat, used in brass and military bands.

Euphorbia, see SPURGE.

Euphorbiaceæ, family of plants distributed over most of the tropical and temperate regions of the globe, especially the warmer parts of America. They are either trees, shrubs, or herbs, some having the external form of the cactus family. Nearly all the members of this large tribe possess a juice, often milky, which is highly acrid and narcotic. Of the species *Euphorbia*, spurge, some 12 kinds are natives of Great Britain. The British spurges are all herbaceous, and remarkable for the singular structure of their flowers, which are green, and their milky juice. The roots of several of the common kinds enter into the composition of some febrifuges, but they are too violent in their action to be used with safety. Irish spurge is used by the peasants for stupefying fish. So powerful are its effects that a small creel or basket containing the bruised plant suffices to poison the fish for several miles down a river. The seeds

of *Euphorbia lathyris* sometimes called in England the caper plant are pickled and form a dangerous substitute for genuine capers. Among the foreign spurges some species furnish both the African and American savages with poison for their arrows. The gum resin *Euphorbium* of chemists is procured from the species growing in Africa and the Canaries by wounding the stem and collecting the sap which exudes into leathern bags. The Manchineel tree (*Hippomane mancinella*) is said to be so poisonous that people have died from merely sleeping in its shade. The fruit looks like an apple and contains a similar but milder fluid. *Jatropha manihot* or Manioc is a shrub 6 ft high indigenous to the W. India and S. America abounding in a milky juice of so poisonous a nature that it has been known to occasion death in a few minutes. The poisonous principle however may be dissipated by heat after which the root may be converted into a nourishing food. It is grated into a pulp and subjected to heavy pressure until the juice is drained off and the residue *cassava* is baked in the form of thin cakes on a hot iron hearth. The juice if boiled with meat and seasoned makes an excellent soup which is wholesome and nutritious.

Euphrates the largest river in W. Asia (1700 m) flowing from the Armenian plateau unit's with the Tigris at Hurna a little above the Persian Gulf. It is regarded as one of the cradles of civilisation. From glacial times the Euphrates has pushed its delta S. hunking up with other streams in its progress and in this way forming lakes marshes and ultimately dry and habitable land.

Its upper part with its tributaries the Kara Su and Murad Su on leaving Armenia unite near Arabkir then find their way into Mesopotamia. The Kara Su is rapid though in parts navigable for rafts. Its sister arm the Murad Su despite its size has never been of value for commercial navigation. A craft is used on its waters to flat bottomed

boats and even shallow-draught steamers where the stream permits.

Below Samawa except during the flood period navigation by steamer is not possible.

Experts are still engaged on the problem of making the Euphrates navigable over most of its course. At the moment attention is being directed to the question of removing the obstacles to navigation in the upper stretches of the river upon which so much depends if it is ever to become of commercial value.

There are ruins of many ancient cities on the banks of the Euphrates including those of Babylon. The traditional site of the Garden of Eden is



N. 110° E. 110° N. 110° E. 110° N.

placed somewhere between the Euphrates and Tigris.

Euphuism, the name given to an extravagant and affected prose style popular in English towards the end of the 16th cent. It is derived from Lyly's *Euphuus the Anatomy of Wit* (1579) and *Euphuus a d his England* (1580) which virtually created the style. It was widely imitated notably by Greene and Lodge and was burlesqued by Shakespeare and others. Its main characteristics are an elaborate balancing of antitheses and the use of similes derived from fabulous and unnatural natural history. As used by Lyly himself this style is free from the grosser blemishes which appear in his imitators. The following is an example taken at random from

Lodge's *Rosalynde*. "When the liquorice leaf looketh most dry, then is it most wet when the shores of Lepanthus are most quiet, then they forepoint a storm. The Baaran leaf the more fair it looks, the more infectious it is, and in the sweetest words is oft hid the most treachery."

Eure-et-Loir, French department, bounded N by Eure, E by Seine-et-Oise, SE by Loiret, S by Loire-et-Cher, and W by Sarthe and Orne. The department is mainly low-lying, rising to a plateau in the NW. It takes its name from its two main rivers, the Eure and the Loir. Agriculture flourishes: cereals, including wheat, vegetables, and apples, are the main crops; cattle and sheep are also raised. The main industries, which are not extensive, are brewing, leather, agricultural machinery, iron, and copper. The chief towns are Chartres (qv), the capital, Dreux, Nogent, and Chateaudun. The department contains many interesting remains of churches and abbeys, a church at St Lubin-des-Jouherets dating back to the 11th cent. Area, 2291 sq m; pop., 255,200.

Eurhythmics, a system of mental and physical culture invented by M Jacques Dalcroze, based on the interpretation of music by means of rhythmic movements of the body and limbs. A carefully graded series of exercises aims at producing an intellectual appreciation of rhythm, combined with perfect physical control, enabling the head and limbs to be moved independently of one another, and so to express several separate rhythms simultaneously.

Euripides (482?-407), with Sophocles and Aeschylus, was one of the three greatest Greek writers of tragedy. His outlook, which has strange and unexpected affinities with that of the later 19th cent., made him less popular than the others with contemporary audiences, and modern critics vary in their judgment of his plays. He is accepted, however, as a master of characterisation. His extant dramas include

Medea, *Alcestis*, *Orestes*, *Electra*, and *The Suppliants*. There have been

many English translations, including those of Gilbert Murray which ably present the spirit of Euripides' writings. Some of the plays have been presented in recent years before English audiences.



Euripides

Europa, daughter of the King of Phoenicia in Greek mythology, was beloved by Jupiter, who changed himself into a beautiful white bull, and carried her off on his back to Crete. Their offspring were Minos, Sarpedon, and Rhadamanthus. The continent of Europe may have received its name from her.

Europe, smallest continent, separated on the E from Asia, by cultural and ethnic rather than geographical boundaries. The conventional line of division is the Ural Mountains and river, the "Manych" depression, the Black Sea, and the narrow waters dividing Anatolia from the Balkans. The continent lies between 71° 6' N and 36° N, and 66° 20' E and 9° 27' W, and is bounded W by the Atlantic Ocean, N by the Arctic Ocean, S by the Mediterranean and its dependent seas. The greatest length, SW to NE, is about 3300 m; the extreme breadth, N to S, is about 2400 m. Area, c. 3,700,000 sq m; est. pop., 475 millions.

The technique of production is more highly developed in Europe than in any other continent except N America. Communications are good and the climate is equable and favourable to man. Political instability has hindered economic progress in many parts, especially to the E, which was long subject to Asiatic attack.

Modern industrialism is common to all W Europe and is most highly developed in Great Britain (the pioneer in such methods of production). Germany NE France and Belgium. Intensive agriculture predominates in France the Danube States and Italy Scandinavia and the Iberian Peninsula yield chief metal ores. In E Europe since the World War modern economic and industrial methods have been adopted by Poland and Soviet Russia. The Danube States and the Balkans are economically the most unstable in Europe.

Geology. The elevation of the great Alpine system of folded mountains in S Europe and the recession of the ice-cap which covered the N of the continent down to the latitude of the Thames left Europe at the Tertiary period in very much her present form. There had been three earlier periods of mountain building. The oldest (Archaean and Palaeozoic) rocks occur along the NW fringe of the continent in N Norway and the Outer Hebrides. Later systems are the Caledonian (or Silurian) trending NE to SW S of the oldest system the Carboniferous or Hercynian. This runs from S Ireland E to the Harz Mountains of central Germany. Along its course many of the principal coalfields are located. Seas and inland lakes have at various epochs covered most of central Europe leaving sandstones salt limestone and chalk deposits.

Coastline. Europe has the longest coastline in proportion to its area of any continent. The large almost inland seas (White North Baltic Irish Adriatic Aegean and Black Seas) and the abundance of natural harbours led to great development in navigation. The peninsular area is very large including Scandinavia the Iberian Peninsula Italy and Greece. The NW and SE coasts are deeply indented. A long stretch of even coastline from the Baltic to the Bay of Biscay is relieved by a number of deep river estuaries. The total length of the coasts is some 48 000 m.

Islands. Europe is fringed by a number of islands. The British Isles to the NW are the largest and most important. Others are Iceland Novaya Zemlya Sardinia Corsica Sicily and Crete. Principal groups are Spitzbergen the Danish Archipelago the Åland Lofoten Shetland and Orkney Isles and the Faeroes and Hebrides in the N the Balearic and Ionian Isles and the groups of the Aegean in the Mediterranean. There are many small single islands—Malta the Isle of Man etc.

Rief. Europe consists essentially of a central lowland fringed by high lands. This central plain embraces most of European Russia and Poland SE Sweden N Germany Jutland the Low Countries N France SE England and W France. N are the Scandinavian and Scottish plateaux S the plain of Lombardy Hungary Bohemia Walachia and Macedonia. The principal S ranges are the Pyrenees Cevennes Alps Apennines Balkans and Carpathians with the subordinate plateaux of Spain Central France and SW Germany. Lower ranges on the N flank of the main fold are the Arvergne Jura Vosges Black Forest and the mountain ring of Bohemia.

Rivers. Europe has many navigable rivers radiating from the two principal watersheds. Flowing E to the Baltic Black and Caspian Seas are the Volga Don Dnieper W Dvina Niemen and Neva. Rivers to the W Baltic N Sea Atlantic and Mediterranean rise chiefly on the S highlands most important being the Vistula Oder Elbe Rhine Meuse Seine Loire Garonne Ebro Douro Tagus Guadiana Rhône and Po. The Danube (q.v.) a deep furrow from the Black Forest E to the Black Sea is the most important waterway. The main streams approach closely and it is possible to travel all over Europe by river and connecting canals.

Lakes. The largest lakes are in NW Russia SE Sweden Finland

and on the flanks of the Alps (*q.v.*) Ladoga, Onega, Saima, Peipus, Ilmen, Vener, Vetter, and Malar, are the chief N lakes, numerous smaller ones are chiefly old glacier beds

Climate Europe lies chiefly in the temperate zone N Russia, Novaya Zemlya, and N Scandinavia are Arctic, the S E of Spain is sub-tropical W Europe is mild and equable, chiefly through the N W Atlantic drift, and is without a great range of seasonal temperature at normal altitudes Rain-fall is fairly consistent at all seasons, decreasing E until continental conditions prevail, with especially severe winters, although the large inland seas modify these extremes S Europe has a Mediterranean climate, marked by dry hot summers and heavy winter rains, conditioned by the alternate W variables and the N E trade winds

Flora A great belt of coniferous evergreens (pines, firs, etc.) occurs in N W Russia and Scandinavia Traces of the deciduous forests (oak, beech, etc.), which once covered the central plain, remain at Fontainebleau, Arques, and as the Teutoburger Wald S Europe has an evergreen forest of myrtle, cork-oak, laurel, and olive S E Russia, where rainfall is slight, is one huge natural grassland; and N E Russia is a vast frozen morass, the tundra Cereals flourish—wheat on the central plains, maize or Indian corn in the E Danube basin and Lombardy, oats, barley, and rye in N Europe and the Baltic Viticulture is possible up to about 40° N, but citrus fruits grow only in Mediterranean countries Fruits such as apple, cherry, and plum are characteristic of the N plain

Fauna. Large wild animals are almost extinct in W Europe Wolves, bears, and wild boars are practically confined to the E—Russia and the Carpathians The rare chamois is seen on the high Alps Principal predatory mammals in W Europe are foxes, and otters, with a few wild cats in remote districts European fauna

is apparently derived from Asiatic and African migrants European deer, however, are not related to the Asiatic species

Minerals Coal and iron are the most important minerals The chief coalfields are in the U.K., Germany, Poland, N E. and S France, Lorraine, and the Donetz district of S Russia Iron ore comes mainly from Sweden and Spain, copper from Spain, and Germany, mercury and lead from Spain, sulphur from Sicily, rock-salt from Poland, N E England, and Germany; potash from Germany and Alsace; precious metals from the Ural district of Russia, silver, in decreasing quantity, from Saxony, petroleum from Rumania and S Russia

Races Asiatic infiltrations, the Finns, Lapps, Tartars, Turks, and Bulgars, have occupied parts of N E. and S E. Europe, and the Magyars of Hungary have spread along the Danube, but the inhabitants of Europe are predominantly of the white race, speaking related Aryan languages There are three main anthropological elements Mediterranean man, long-skulled, rather short, with dark hair and eyes, represented chiefly by the S French, the Iberian races, Greeks, and Italians, Alpine man, round-skulled, with brown hair, medium complexion and stature, found largely in S Germany, among the Slavs, and in Belgium, and the Nordic type, robust, flaxen-haired, blue-eyed, long-headed, and usually tall, typical of the Baltic and Scandinavian regions Inter-marriage has produced many intermediate varieties, and migration has produced a great mingling of races, so that flaxen types are known in the Mediterranean, and some dark-headed Castilians are tall The British Isles have, perhaps, the most mixed population of all

Religion. The Christian religion, professed almost everywhere outside Turkey, is divided chiefly between the Roman Catholic, Protestant, and the Eastern Orthodox Church Protes-

anism is predominant in Britain Germany the Netherlands Benelux parts of Switzerland and Scandinavia Catholicism is strongest in the Latin countries S Germany Austria Czechoslovakia Hungary and Poland The Eastern church is supported chiefly by the Slavs of the Balkans except certain Yugoslav districts which are mainly Catholic under the Soviet Government the Eastern Church has lost much of its influence upon the people of Russia where it had for centuries its strongest hold Mohammedanism is still pre-va-lent in many parts of S Europe formerly under Turkish domination notably in Bosnia Herzegovina Albania and Bulgaria

Commerce Europe's political boundaries tend to cut across natural economic areas so that internal competition is severe and often highly uneconomic Great Britain France and the Netherlands have large colonial dependencies which further tend to detach their interests from the continent and Russia for political reasons follows a separate course

Political Divisions The chaotic position in Europe has been accentuated by redistribution of territory after every war without due heed to economic and nationalistic boundaries Treaties after the World War broke up the Habsburg and Hohenzollern empires and created new States The principal contemporary States are Great Britain Belgium the Netherlands Denmark Sweden Norway Italy Hungary Yugoslavia Bulgaria Rumania Albania France Spain Portugal Germany Switzerland Austria Czechoslovakia Poland Greece Turkey Finland Estonia Latvia Lithuania and the U S S R The greatest concentrations of population are in the W industrial areas Belgium Great Britain and Germany are respectively the most densely inhabited Russia has by far the largest aggregate but her people are widely scattered The largest European cities with their suburbs are London (8 204 000) Ber-

lin (4 883 114) Paris (* 871 000) Moscow (* 781 000) Leningrad (2 780 000) Vienna (1 886 000) Warsaw (1 178 000) Glasgow (1 088 000) Hamburg (1 079 000) Rome (1 008 000) Budapest (1 006 000) Birmingham (1 016 000) and Barcelona (1 000 000)

Communications The European railway systems are highly developed they are dealt with in detail under their various countries Only N Russia is without extensive communications Paris and Berlin are the principal continental railway centres Important lines run from Paris to Belgium Germany Switzerland Italy Spain and the Channel ports (for England) Berlin is the centre for Moscow Warsaw and S Central Europe The famous *Orient* route runs from Paris via Strasbourg Munich Vienna Budapest and Belgrade to Constantinople An alternative route the *Simplon Orient* runs via Milan Zagreb and Belgrade The R Danube Rhine Elbe Oder and Vistula are important means of communication and transit has been facilitated by the extensive building of canals Roads in W Europe are generally good but in the Balkans even the main roads are still sometimes impassable in bad weather Air services have been greatly developed in recent years All the more important seaports are connected by steamship and motor vessel services

History and Civilisation Four distinct elements have blended and reacted to produce modern European civilisation Greek art and speculative thought Roman jurisprudence and Jewish religious experience culminating in Christianity carried the Mediterranean civilisation to its zenith under the Roman Empire The fourth element brought an apparent regress on in civilisation the Western Empire collapsing before the Teutonic tribes during the 5th cent AD But through the infusion of this new energetic race the older civilisation was eventually renewed From Teutonic institutions grew some

sentative government, modern democracy, and a conception of individual liberty which made possible the Reformation and Renaissance. From Greek speculation came all progress in science and political theory, almost all the institutions of government are known to-day by the names given by the philosophers of Greece. Her literature and art have moulded progress; her achievements have scarcely been surpassed. Greek treatises, though often wrong, created the curiosity which led to discoveries and produced modern science. But the Greeks were unpractical, and it was reserved to Rome to evolve political stability. Her genius was pre-eminently legal and practical. She united Europe W. and S. of the Rhine and Danube to the Mediterranean civilisation. Roman jurisprudence was the foundation of legal practice in almost every European nation. Christianity, arising in obscurity, captured the Roman Empire in the 4th cent. As a civilising influence its work was immense but impalpable, working through individual conscience and the belief in the essential relation of morals to religious outlook. The church conserved the governmental and administrative tradition of Rome and preserved the literature of the ancients. The most apt of the pupils of Rome among the Teutonic races proved to be the Franks. Under the great Carolingian dynasty, in whom the W. Empire was theoretically revived, most of Europe to the Elbe was brought under Christianity and Western government. The Carolingian Empire, however, under fresh barbarian incursions degenerated into the curious politico-ethical order of society known as feudalism. The modern State system evolved out of feudal chaos. Germany was not united until the 19th cent., but meanwhile had carried European culture to the neighbouring Slav and Magyar kingdoms. The earliest unified States were those of the Atlantic

coast, dating from the Renaissance.

Exposed to the attacks of Asia, and remote from Western progress, E. Europe changed slowly. Byzantine culture, tinged with the Orient, transmitted European civilisation to the Balkans and Russia. The latter entered the European commonwealth in the 18th cent., but is only just becoming Westernised. The Balkan States are the most backward in the continent.

Modern Europe has witnessed the triumph of nationalism, but behind its apparent diversity is essential unity in racial composition and inherited culture which may yet rise superior to the artificial barriers due to political considerations.

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Eurogium. For the characteristics of europium see **ELEMENTS**. A metal belonging to the group of rare earths (q.v.). It is of no practical interest.

Eurydice [*Ūr'ōisē*], in Greek legend, the wife of Orpheus (q.v.), who was so grief-stricken at her death that he descended to Hades in search of her. He obtained her from Pluto on condition that he did not look at her until they had emerged from the underworld. They had almost reached the upper regions when Orpheus could restrain himself no longer, turned, and looked upon Eurydice, who was immediately and for ever drawn back into Hades.

Eusebius, name of several bishops in the Early Church. The most important were: the Bishop of Vercelli (c. 370), an opponent of Arianism, and the Bishop of Caesarea (c. 265-350), author of a highly valuable *History of the Church* to 328.

Eustachian Tube, see **EAR**.

Eutaw Springs (S. Carolina), Battle of (War of American Independence),

Sept 8 1781 the last serious engagement of the war The British under General Stewart gained a victory which they were not able to follow up over the Americans under Greene

Eutechio, *see* ALLOYS

Eutechoid, *see* IRON AND STEEL

Enterpe (Ἔρπη) in Greek mythology the muse who presided over lyric poetry and the music of the pipe and flute

Entropius (4th cent A.D.) Roman historian held high State appointments and was secretary to the Emperor Julian His work *Brutium verum Romanorum* is a short and simple history once popular as a school book.

Evangelical Association, a religious sect similar to the Methodists founded in N America by Jacob Albrecht 1803 Branches have been formed in Germany

Evangelical Union, a religious sect founded by James Morrison in 1843 after his expulsion from the Scottish Presbyterian Church for heresy The church is Congregational and denies the Calvinist doctrine of election (*qv*)

Evans, Sir Arthur John (b 1851) British archaeologist Keeper of the Ashmolean Museum (1884-1906) undertook expeditions in Finland Lapland (1873) the Balkans (1876) and Crete (1893) He is best known for his discoveries at Knossos and other places in Crete where he worked almost continuously from 1893 to 1933 (*see* *ÆGEAN CIVILISATION*) His works include *Cretan Pictographs and Pre Phœnician Script* (1896) and *Scripta Minoa* (1909)

Evans, Garadoc, modern novelist born in Wales was for some time a journalist and has written plays Of his novels which are remarkable for their biting satire of his Welsh compatriots *Nothing to Pay* and *Wasps* are examples

Evans, Vice Admiral Edward, R.N. (b 1881) British sailor and explorer Entering the Navy he served in the relationship to the *Discovery* expedition, 1902-4 and was second in-command in

Scott's Antarctic expedition 1909-13 taking charge on Captain Scott's death He commanded H.M.S. *Mohawk* in the bombardment of the German Army on the Belgian coast 1914 and was in command of H.M.S. *Broke* which, with H.M.S. *Suff* engaged and defeated 6 German destroyers 1917 He commanded H.M.S. *Carlisle* and *Pepulse* after the War and in 1919 was appointed Rear Admiral commanding the Royal Australian Navy In 1933 he became Commander in Chief of the Africa Station and Acting High Commissioner of Bechuanaland Author of *South with Scott* (1911) and *To Sweep the Spanish Main* (1930)

Evelyn, John (1600-1706) diarist friend of Pepys with whose diary however his own has little in common He travelled widely and had an inside knowledge of the politics of his day His *Diary* therefore is a record of history in the making and his interpretation of events is interesting and instructive He wrote many books on historical and economic subjects and on gardening in which he was an acknowledged expert Of these *Sylva* was the most important it dealt with afforestation and led to great developments in that direction

Evening Primrose (*Oenothera*) a herbaceous plant of the order Onagraceae allied to the willow herb (*qv*) It is common in gardens attains a height of 3 ft and has lanceolate smooth leaves and spikes of large pale yellow flowers which open in the evening and close towards the middle of the following day It is biennial and flowers from July to Sept

Everest, the highest mountain in the world a peak of the Himalayas situated in Nepal Trigonometrical methods have established its height as 29 140 ft It is named after Sir George Everest who surveyed the Himalayas in 1841 and was the first to measure the height of the peak Several expeditions have been made in an attempt to climb the mountain principally in 1905 and 1924 They were preceded by a reconnaissance ex-

pedition in 1921, which mapped the country N of the mountain, and discovered the most promising line of ascent. Early in 1922 the first real attempt was made, and a camp established at a height of 25 000 ft., then a record height for a camp. From this base three attempts were made, and on the second occasion a height of 27,300 ft was reached. On the third attempt an avalanche overwhelmed the party, and 7 members were killed.

The 1921 expedition chose a route not so exposed to avalanches, but steeper and more difficult. On this occasion a camp was pitched at 27,000 ft., and a maximum height of 28,200 ft reached, but 4 members of the expedition lost their lives. In both the expeditions the chief difficulties were the breakdown of the transport and the necessity of completing the ascent before the onset of the monsoon at the end of June. Early in 1933, for the first time, a flight was made by aeroplane over the summit of Everest, and photographs were taken which added considerably to the knowledge of the configuration of the mountain.

Evergreens, plants which retain some green leaves throughout the year. The shedding of leaves is a response to seasonal change, and the onset of conditions in which water loss from the leaf surfaces would exceed water intake by the roots, but certain plants have hard leaves of peculiar internal structure, covered with a thick skin through which water cannot pass, and so lose little even under the driest conditions. Thus they remain on the plant to carry on food-making processes throughout the cycle of seasons. Plants of tropical rain forests also retain their leaves for a long time, and, as the production of new leaves goes on continuously, they are never devoid of leaves.

Everlasting Flowers. The *Helichrysa* are the most useful of all everlastings. They are of very easy culture, and bloom with great freedom.

The flowers are many-coloured, and have a peculiarly beautiful glossy surface. They are invaluable for cutting and for decoration during the winter months. The flowers are large and gay. They should be cut when partly expanded and suspended head downwards in a cool place.

Gnaphalium is an allied genus, also belonging to the Composite family. Most species are hardy annuals or biennials.

Messenbryanthemum tricolor is a tiny, half-hardy annual, whose flowers are also useful for winter decoration.

Honesty, or *Lunaria*, is a cruciferous plant with uninteresting vegetative habit, and has blue, white, or purple flowers which are not remarkable, but the flattened discs on which the seeds are borne are a clear ivory colour, and make beautiful everlasting "flowers" which are deservedly popular. The species are all hardy annuals which thrive in any garden soil, and flower in May.

Statice, or Sea Lavender, is a hardy perennial. The seed should be sown in spring, and the seedlings put into their permanent quarters in the autumn, for flowering the following season. The "flowers," which persist through the winter on cut shoots, are coloured bracts.

Everlasting League, formed in 1291 by certain Swiss cantons for self-defence against Austria. After defeating Austria in 1315, the League decided to formulate a common foreign policy.

Evesham, Battle of (Barons' War, Aug 4, 1265) the Royalists in largely superior numbers under Prince Edward defeated the Barons under Simon de Montfort, who was slain at Evesham, Wores, thus ending the war.

Evian-les-Bains, a thermal resort on the French shore of Lake Lemman, Switzerland. The town is built on a slope, all above 1230 ft. It is within reach from Lausanne, Montreux, and Vevey. The Source Cachat springs, of bicarbonate of soda mineral water, are well known. Pop. (1925) 3200.

Eviction, see LANDLORD AND TENANT MORTGAGE

Evidence, any fact which tends to produce in the mind a persuasion of the existence of some other fact. The English system of law which relies on the decision of a jury of men untrained to weigh up and sift evidence has rendered necessary the development of a large body of rules relating to evidence and designed to make the task of the jury easier. They are not however highly artificial rules but are based on strict common sense. They fall into 3 divisions—relevancy, proof and cogency.

Firstly it is clear that only those facts should be proved which are *in issue* i.e. disputed facts upon which the claim or the defence depends for success or facts relevant to the issue. The law has consequently laid down certain rules determining what facts are admissible in evidence and these rules are stricter than the rules of ordinary life. *e.g.* the fact that A once committed a theft is not legally admissible to prove that he committed the theft with which he is now charged though in every-day life this would probably be taken into consideration.

Secondly the facts must not only be relevant but must be proved in a proper way. In certain cases no proof is required: the court will take judicial notice of certain facts *e.g.* the accession of a sovereign. Other facts must be proved sometimes by the evidence of a witness, sometimes by documents or the production and inspection of things (*e.g.* of goods asserted to be defective) and the rule is that the best evidence available must be produced. It would be useless to call a witness to say what is in a certain document if the document itself is available. Evidence may be either *direct* going straight to the matter in issue as an eye witness's account of a murder or *circumstantial* the evidence of a chemist who sold arsenic to a person accused of poisoning by arsenic. The task of proof may be made easier by the existence of *admissions* made by the defendant or

again it often happens that from certain proved facts the law will make *presumptions* as to the existence of other facts and then the opposing party will be forced to *rebut* or disprove the presumption *e.g.* a letter proved to have been properly addressed and posted will be presumed to have reached its destination. Again the other party may not be permitted to set up and prove a certain fact: thus if A leads B to believe a certain thing and B acts upon this belief A will not be allowed to say that that thing never existed. This is called *estoppel*.

Finally comes the question of cogency which does not arise until the question of admissibility has been decided and the fact proved. What weight is to be attached to a particular piece of evidence? The question cannot of course be solved by rules but must always depend on the circumstances. Decision rests with the jury though the judge can give valuable help by analysing carefully the evidence. *See also* PROOF BURDEN OF WRITINGS.

Evidence Circumstantial Judicial evidence is either direct or circumstantial. It is direct when the fact to be proved can be attested directly by witnesses who were present who saw or heard as the case may be or by things and documents. It is *circumstantial* as it must almost always be in the case of crimes secretly committed when there is no evidence to the fact itself but only to matters closely connected with it. *e.g.* in a case of poisoning the chemist who sold that particular poison to the prisoner: the sale is circumstantial evidence. Both types of evidence are equally admissible but the former naturally carries greater weight than the latter.

Evidence King's, see APPROVER

Evipan, short name for a recently discovered anaesthetic which is given by intravenous injection. It quickly produces a surgical anaesthesia lasting for 6-10 minutes and so is used in minor operations to avoid the psychic

shock of anæsthesia by inhalation. Chemically, it is the sodium salt of N-methyl-cyclo-hexenyl-methyl-barbituric acid.

Evolution, literally an unrolling, is a process of orderly change. A study of evolution attempts to trace the changes to their origin and to account for their occurrence. Repeatedly in history, nations have evolved progressively until, after reaching the zenith of their fame and power, their evolution has proceeded as a more or less rapid decline, resulting, in some cases, in their obliteration. The rise and fall of the Assyrians and Babylonians provide an illustration of this. Thus evolution may be both progressive and retrogressive. The disappearance of species, genera, and even of families, of plants and animals has taken place while new species and genera have arisen. The complicated modern steam-engine has been evolved from a simple kettle of boiling water. On the other hand, pieces of machinery, now worked easily and simply, have been enabled to do so by a long series of improvements and complications that are not apparent. Similarly, the evolution of organisms almost certainly proceeded at first from relatively simple to more complex forms. While the sociologist is concerned with the evolution of society, the historian with the evolution of nations, and the scientist with the evolution of his particular science, to many people the word "evolution" is connected vaguely with Darwin and monkeys. This article will consequently deal with what is termed the *Theory of Evolution*, and the evidence on which the theory is founded.

The hypothetical organisms, believed to be the ancestral forms of all subsequent living creatures, have been named *Protista*, and must have resembled certain bacteria in their ability to assimilate inorganic compounds. Whereas some evolutionists, the mechanists, think that living organisms once arose from material generally recognised as inorganic and

non-living, others, the vitalists, think that life in some way was added to the physico-chemical structure. Both mechanists and vitalists agree that once living organisms appeared, others were produced by their propagation and that forms recognised as living now arise only by the reproduction of others. A third view is that every different species was created separately, and has been maintained by propagation through the ages. This theory will be discussed after reviewing the evidence for and against the different views—evidence based mainly on paleontology (*qv*), embryology (*qv*) and phylogeny (*qv*). For simplification, plants and animals will be considered separately.

Animals. Palæontological Evidence. The preservation of dead organisms in the different geological strata is dependent mainly on the structure of the organism, and on the nature of the material surrounding it. Generally, the soft parts of plants and animals decay, and only the hard parts such as the firm cell walls of plants and the skeletons of animals are preserved. Consequently, evidence of the existence of the Protista, and of soft-bodied animals such as various kinds of worms and Protozoa, cannot be expected in the oldest strata. The absence of fossils and casts of animals and plants cannot be accepted as proof that they did not exist.

The oldest-known fossils are those of invertebrate animals, but the structure of these is far from simple. *Trilobites* (*qv*), an order of the *Crustacea* (*qv*), were found in the Cambrian rocks with many crinoids, *Echinodermata* (*qv*), *Brachiopoda* (*qv*), and *Cephalopoda*. The living representatives of these animals can therefore, according to some estimates, trace their ancestry for over 25 million years. Other estimates give 50 million as more probable. In either case the ancestors were even then, judged by their structure, well advanced in their evolutionary course. With comparatively long intervals between the

occurrence, fossils found in successively upper strata are those of Fishes, Amphibia, Reptiles, Mammals, and Birds (qq v) Man, the most specialised Mammal, has a very short fossil history

The supposed evolution of the horse from a five-toed ancestor can be traced to the Lower Eocene, where small, long-tailed animals, having five toes, comprise the genus *Phenacodus*. The size of different species of these animals varied between that of a suckling-pig and of a lamb, and they moved on their toes. Higher in the strata is the genus *Hyracotherium*, the oldest horse-like animals, about as large as hares, and having hands (i.e. fore-feet) with only four digits. The first digit, corresponding to our thumb, was not developed, but in another genus, *Eohippus*, this was represented by a thin rudimentary bone termed a splint bone. *Eohippus* was about one-sixth the size of a modern horse, and had feet with three toes, the fourth being represented by a splint bone. On both hands and feet, the third or middle digit was stouter and longer than the others.

Following *Eohippus* came *Protorhippus*, a genus of animals, c. 14 in high, with no rudimentary thumb. They were succeeded in the Middle and Upper Eocene by the slightly larger *Orohippus*, with feet similar to those of the preceding genus, but with more highly developed molar teeth. In the Upper Eocene another genus, *Epihippus*, appeared. The hand bore four fingers, the two lateral ones being very thin and small, and the foot had three toes with only the middle one well developed. The teeth showed an advance in structure. Similar but larger forms, *Mesorhippus* and *Miohippus* in America, and *Anchitherium* in Europe, are found in the Oligocene, and in the next period, the Miocene, fossil forms are abundant, and the group seems to have reached its maximum. All the genera consist of three-toed animals having a well-developed middle toe and the lateral ones very

reduced. This reduction, accompanied by an increase in size, is carried farther in *Phorhippus*, found in the Pliocene and Upper Miocene America, and in the genus *Hipparchia*, which also appears in the Pliocene. In all these genera the third digit is the only one developed, the two lateral ones on hands and feet being reduced to splint bones. Contemporaneously the European genus, *Hipparchia*, was three-toed. *Equis*, the genus including modern horses, became extinct in America during the Pliocene period, but has gone on continuously in Europe until the present day.

Similar evidence, though less complete, exists of the evolution of elephants, camels, whales, reptiles, Mollusca, and various other animals.

Man is a Mammal, included with marmosets, monkeys, baboons, and apes in the sub-order *Anthropoidea*, the *Primates* (q v). The earliest fossils of *Primates* are found in the Lower Eocene, and are thought to have had a common origin with carnivores, but the complete series of fossils has not yet been discovered. The oldest known fossils of *Primates* belong to the early Pleistocene epoch and are the famous London skull, which Sir Arthur Keith suggests may have been the ancestor of modern man, and the more ape-like Taungs skull, blasted out of a limestone cliff at a depth of 80 ft., at Taungs, 80 N of Kimberley, S Africa.

The first Neanderthal man, found in 1856, had so extraordinary a skull that some scientists regarded it as a degenerate type, while others decided that it was human. Various other human fossils have since been discovered, including the erect ape-like *Pithecanthropus erectus*, the Pitted skull, with larger cranium, and the Cro-Magnon skull with a slightly larger cranium than that of average Europeans.

No fossils have yet been discovered that are indisputably regarded as common ancestors of man and

other anthropoid Primates, but jaws and teeth found in Egypt and India are more primitive than those of fossil apes and somewhat resemble human molars. On account of the conformation of its skull and the structure of its teeth, some scientists believe the Miocene ape, *Dryopithecus*, or a similar ape, to be the "missing link," the long-sought common ancestor of man and ape. Other scientists believe the ancestral form to be more primitive.

The Evidence of Embryology (qv) Early in the 19th cent von Baer discovered that the embryos of mammals developed so similarly that at certain stages of their development it was at first sight difficult to distinguish between the embryos of the rabbit, dog, man, and various other mammals. Moreover, these mammalian embryos in their earlier stages closely resembled embryos of fishes, amphibia, reptiles, and birds. As a result of this discovery, Haeckel concluded that the embryo in its development passes through the same sequence of stages as its ancestors passed through in the history of the race. This was Haeckel's *Biogenetic Law*, frequently referred to as the *Theory of Recapitulation*. In other words, the individual in its development, recapitulates the racial history.

In tracing the development of the vertebrate embryo with a view to showing its racial descent or *phylogeny* (*qv*), obvious gaps and obscurities occur. Haeckel's supporters account for the gaps by stating that every phase of the phylogeny cannot be repeated in the short period of time taken for the development of the embryo, and hence the relatively unimportant phases are eliminated. For example, although man had remote piscine ancestors, the fish-like phase is now unimportant, and shown merely by gill pouches and the development of gills. Obscurity in the sequence of the development of the individual and of the race. The theory of recapitulation is not

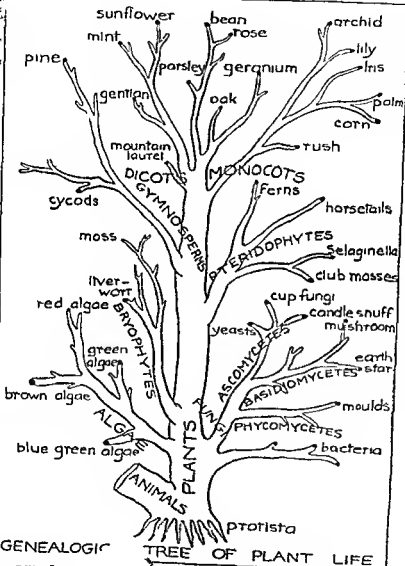
considered true in such detail as Haeckel first suggested it. Probably every embryo recapitulates ancestral phases, and relationship of every different adult forms is shown by embryology. Certain Crustacean parasites, such as *Sacculina*, become, when adult, little more than shapless bags of eggs, but their larval phases are similar to those of normal Crustacea and consequently *Sacculina* is included in that class.

It must, however, be remembered that even if an embryo passes through definite phases of development, at no phase could it ever develop into a different species of animal, nor would experts ever mistake an embryo of a chick, for instance, for that of a reptile or of a mammal. The piscine stages of these embryos are always distinguishable from the embryos of fishes, and from one another.

Evidence of Phylogeny (qv) Homology (*qv*) affords a basis for the classification first of individuals as species, and subsequently for the collection of species into genera, of genera into families or natural orders, and of these ultimately into phyla. For example, consideration of the skeleton shows that the arm of man, the arm or foreleg of beaver and giraffe, the flipper of a whale and the wing of a bird, all are similarly constructed, although performing different functions. This common plan suggests a common origin—a suggestion reinforced by other similarities of structure both in the skeleton and in the muscular, nervous, circulatory, digestive, and urogenital systems (all of which see).

In effecting a system of classification it is found that often one species grades into another, that individuals of one genus are similar to those of another, and even that phylum grades into phylum. In studying a scheme of classification of plants and animals, the sequence of individuals, from the lowest to the highest, becomes evident, and suggests a sequence in time, i.e. an evolutionary sequence.

Other Evidence Vestigial structures



found in many organisms can be explained only by the supposition that they were well developed in remote ancestors. The coxyc of man is a vestigial tail, the small fleshy lump in the inner angle of the eye, the remnant of a nictitating membrane; the hairs on the trunk and limbs, a rudimentary hairy coat.

Confirmatory evidence of relationship in vertebrate animals is yielded also by blood tests. When blood of one animal is injected into the circulatory system of a closely related animal, the two kinds of blood corpuscles take place and blocks the capillaries. Human blood may be successfully transfused into a chimpanzee and other anthropoid apes, but not into a bird nor even a lemur. Similarly, blood may be transfused from a horse to a donkey or *vice versa*, but not from a horse to a goat or a cat.

The probable evolution of animals is shown in the accompanying diagram as a tree with the Protista at its base, and main branches arising from an ancestral stock at different geological periods. The main branches produced divergent individuals, giving rise to various orders and genera.

Plants (qv) The sources of evidence of the evolution of plants are similar to those considered for animals. The structure of the lower plants does not favour their preservation as fossils, and in the Cambrian epoch there are preserved even fewer plants than animals, consequently, there is little direct information on the remote ancestry of plants.

The Mode of Evolution Only a few examples have been given of the vast amount of evidence which has made scientists believe in the process of organic evolution, although they may have different opinions about the probability of the evolution of organic from inorganic material. A view once commonly held was that every species was specially created and maintained by propagation as a distinct immu-

table species. If this were the case, the occurrence of multiple species into one, a view of the rigidity of species, and the paleontological record (creations would have occurred at various times throughout the eras, but not occurring at the present time, recognised as offshoots of living organisms, and not as creations, and there is no reason for regarding them as any process, though not accepted by some prominent scientists, from a much more reasonable interpretation of all the evidence than does the last of a series of separate creations.

Granted that evolution occurred, how did it take place? Darwin described it to variation (*qv*) and natural selection (*qv*). Every organism in some respects from its parents. Darwin (*qv*) thought that organisms having adaptations (*qv*), would tend to survive, and the variation in their would be sufficiently marked to warrant the inclusion of the organism as a new species. Organisms not possessing favourable variations would tend to become extinct. The influence of the environment on the survival of extinction of favourable and unfavourable variations Darwin termed **Natural Selection**. He assumed the transmission of the power to produce favourable variations, an assumption not completely justified by the evidence of genetics (*qv*) and heredity (*qv*). Opponents of the theory also point out that natural selection operates so slowly that it cannot account for the great changes shown in fossil series. More recent work shows that plant and animal mutants (*qv*) sometimes occur suddenly, and that mutations may be transmitted. These may account for the sudden occurrence of new species.

Lamarck thought that organisms adapted themselves to their environment, and that adaptations produced

by the parents would be inherited and perhaps intensified in their offspring. This theory is generally described as the theory of inheritance of acquired characteristics. It would explain the evolution of the horse for instance by supposing that the five-toed ancestor adapted itself to changed soil and general environment by using its lateral digits less and less. Successing generations would consequently produce shorter and shorter lateral digits until eventually they disap-

pear for the transmission of the hereditary factors and a change in the chromosome constitution of the germ cells affects the characteristics of the individual arising from them. In some cases hormones (q.v.) may effect germinal changes.

While variation, heredity and competition in the struggle for existence have been the main determinants in the evolutionary process, isolation also has played an important part. Darwin found in the Galapagos Islands 26

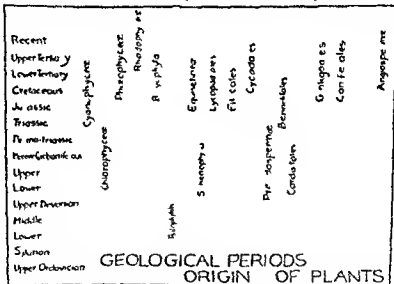


Table showing Age and Duration of the Chief Groups of Plants and Fossils

peared and the four-toed horse and subsequently the three-toed form would evolve. Similarly the one-toed horse would be derived from the three-toed ancestor. This theory, which will be more fully discussed under heredity (q.v.) is not supported by experimental evidence, but it has been shown that changes in the germ cells sometimes occur and result in changes in the individual. The chromosomes in the cell (q.v.) provide a material basis

for the transmission of the hereditary factors and a change in the chromosome constitution of the germ cells affects the characteristics of the individual arising from them. In some cases hormones (q.v.) may effect germinal changes. While variation, heredity and competition in the struggle for existence have been the main determinants in the evolutionary process, isolation also has played an important part. Darwin found in the Galapagos Islands 26 kinds of land birds not found elsewhere. The sea had effectively cut off the fauna from communication with the main land. Physiological isolation due to the prevention of various matings by the attainment of sexual maturity of the sexes at different periods of the year by incompatibility of size and structure and to infertility, owing to differences in the germ cells themselves, plays its part in the course of evolution.

Whereas evolution usually results in

the production of divergent types, it may also be convergent. The lizard and newt, for example, although unrelated, have apparently very similar structure. Bats, birds, and insects have all produced wings, but of very different origin. Convergent evolution may generally be regarded as the result of the adaptation of different forms for similar functions, and instead of helping in the determination of relationships, it may be very misleading. See also ANALOGY, ANTHROPOLOGY, PHYSICAL, BIOGENESIS, FOSSILS, GEOLOGY, HOMOLOGY, BIONOMY. *The Origin of Species*, by Charles Darwin, *Evolutionary Biology*, by Arthur Dendy, *The Story of Evolution*, by B. C. Grunberg, *The Antiquity of Man*, by Sir Arthur Keith, *Evolution*, by J. A. Thomson and P. Geddes, *Evolution of Plants*, by D. H. Scott.

Evreux [Ā-vrē], town, capital of Eure department, S. of Rouen, France. There is an 11th-cent. cathedral in the town, but no other monuments of note. The industries are glass-blowing and iron-works, the surrounding country is devoted to fruit culture and stock-raising for the market at Evreux. On two occasions the town has been set on fire, once by Henry I of England (1119) and later by Philip Augustus. The clock-tower was erected by the English in 1417. Pop. 18,840.

Ewe, see SHEEP.

Ewing, Sir James Alfred (b. 1855), British engineer and physicist, at first assistant to Lord Kelvin in engineering work, was Professor of Mechanical Engineering at Tokio university (1878-83), where he studied earthquakes, embodying the results in a *Treatise on Earthquake Measurements*, (1883). He then became Professor of Engineering at University College, Dundee, and in 1890 Professor of Applied Mechanics at Cambridge. In 1903 he left Cambridge on his appointment as Director of Naval Education, and in 1916 became Principal and Vice-chancellor of Edin-

burgh University, retiring in 1929. He invented several devices for testing the quality of iron, such as a hysteresis tester and a permeability bridge.

Examinations, tests of capacity following a definite course of study. In the 12th and 13th cents., candidates for degrees had to submit mainly to an oral test, which consisted in defending a thesis against one or more examiners. In the following centuries written examinations (see EDUCATION IN THE MODERN STATE) became more frequent, and nowadays are the general preliminary to entry into most professions. The average child's school years are marked by a series of examinations. If he starts at an elementary school, there is first the examination for entrance to a secondary school at the age of 11. There follows the school-leaving examination, and/or matriculation. This examination passed, another 2 years' study leads to the higher school certificate, and a further 2 or 3 years at a university leads to the bachelor's degree. If a person enters the Civil Service (q.v.), each upward stage is marked by another examination.

Varying with the subject and standard required, examinations tend to fall into 3 divisions: (1) written, (2) oral, (3) practical, the importance attached to each section being dependent on the profession.

As personalities vary, so that examiners and pupils both have varying reactions to examination, and as a rigid standard for passes is manifestly unfair when questions relating to perhaps 4 years' study can cover such a tremendous field, it is beginning to be realised that formal examinations are not the best test of capacity. There is a growing tendency to question their value.

Exarch, a title borne by both political and religious governors under the Eastern Empire, e.g. Exarch of Ravenna, it is still used as an ecclesiastical title in the Eastern Church, where, e.g., the head of the Bulgarian Church is called an Exarch. **Exarchate of Ravenna**, an Italian

State under the government of an Exarch which recognised the authority of the Emperor of the Byzantine Empire from the fall of Rome until A.D. 752. The territory was gradually dismembered by Lombard conquests and by the growth of the Papacy as a secular power.

Excalibur [EXSKA LIRÓ] the sword of King Arthur who received it from the Lady of the Lake. At Arthur's death Bedivere cast it into a lake where it was caught by a mysterious hand.

Excavator see DAKDRA

Excellency a title of honour first assumed by Charlemagne in the 9th cent. To-day it is applied to all ambassadors and in Great Britain to the Viceroy of India and the governors of colonies. In the United States it is assumed by the Governors of States only but in Italy it is a common form of polite address.

Exchange in economics not only transactions in the nature of barter but also all sales of goods or services for money whether paid for by cash, cheque, bill of exchange, draft etc.

The name is also given to stock and produce markets such as the Stock Exchange (*qv*), the Cotton Exchange and the Coffee Exchange etc. The Baltic Exchange (*qv*) is another example. *Foreign Exchange* is the buying and selling of foreign currencies and Bills of Exchange (*qv*).

Exchange, Bill of, see BILL OF EXCHANGE

Exchange Equalisation Account, a fund provided by the British Government and managed by the Bank of England for combating excessive speculation and thus preventing wide fluctuations in the exchange value of the pound sterling. When a currency is divorced from gold its value in relation to other currencies is liable to fluctuate from day to day since its exchange value is determined by the supply and demand for the currency for exchange purposes and also by speculative activities (see GOLD STANDARD). When Great Britain suspended the gold standard in Sept. 1931 it was

decided that efforts should be made to prevent wide day-to-day fluctuations though it was realised that any real upward or downward trend could not be controlled by Government intervention. The Bank of England operated in the market for some time buying or selling dollars or francs to achieve this purpose. Since the resources of the bank were limited and the risk of heavy loss was greater than it should assume a special account was created by the Government on July 1, 1931 of £150 millions to which was added an old dollar exchange fund of £95 millions which the Government had maintained previously. In May 1933 the Exchange Equalisation Account was increased from this £175 millions to £375 millions. The account may hold gold, sterling or foreign currencies and buy or sell from one to another to iron out fluctuations in sterling. Operations have been chiefly in dollars and francs—though since the United States left the gold standard the account's activities have been directed to steadying the value of sterling in terms of French francs and in part Dutch guilders. The effort of those operating the account is to make speculation in sterling as dangerous as possible.

Funds were first provided by the issue of *Treasury Bills* (*qv*) sold to the Bank of England when and as funds were needed. Foreign Exchange is bought with these funds from a bank or other institutions in the London Market the seller being paid by a cheque which increases his deposits with the Bank of England. Thus the purchase of Foreign Exchange has a slightly inflationary effect as it increases the cash of the bank while a sale of foreign exchange has the reverse effect. See also BANKING AND CREDIT.

Exchequer (or *Treasury*) Government department dealing with State finance introduced by the Normans. The name is derived from *schacher* (chess board) or Lat. *scaccarium* the original name of the department. It consisted of two departments the

developed behind the pronephric tubes. These become connected with the original longitudinal duct, forming the mesonephros. In some fishes, e.g. sharks and skates (Plasmodobranchs) the mesonephros itself becomes divided into a front and a rear part, of which only the latter acts as the renal organ. This part is often called the metanephros, but more properly the term mesonephros is applied to the whole organ. The longitudinal duct in the male becomes the genital duct or vas deferens, and the tubes from the active part of the kidney unite to form a ureter which opens into the lower end of the longitudinal duct, close to the cloaca. In the female the tubes from the rear part of the mesonephros open into the adjacent part of the original longitudinal duct, the upper part of which is a functionless vestige. No fishes have a urinary bladder.

In the Amphibia the excretory organs are in the main like those of the dogfish. In the newt the kidneys show a similar division into a smaller anterior and a larger more functional posterior portion, but this is not the case in the frog and in the males of both the genital products pass through the kidney or mesonephros and make their way by the urinary ducts to the cloaca. From the cloaca the urine is collected into a bilobed urinary bladder, which opens into it.

In the Reptiles the front part of the kidney, the mesonephros of the Amphibia, is enclosed in the embryo, but is not the kidney of the adult. It atrophies, or is represented by a mere vestige in the female, and in the male becomes associated with the genital gland, or testis, where it forms the so-called epididymis, and its ducts unite as the vas deferens. The kidney is a metanephros and its tubules unite to form a duct, the ureter, which conveys the urine to the cloaca, whence, in some orders, the tortoises and lizards, as in Amphibia, it passes into a bladder.

In Birds the kidneys are of the same type as those of Reptiles. They are large lobed glands, closely applied to

the vertebrae of the pelvis. The ureters open into the cloaca, but there is no urinary bladder and the urine itself contains no water, as it does in Mammals.

In Mammals also the kidney is a metanephros like that of the Reptiles. It is typically a compact bean-shaped organ, and the tubules it contains unite at a point on its inner surface, called the pelvis of the kidney, whence the duct or ureter passes backwards and, except in Monotremes, opens direct into a urinary bladder.

Ex Dividend, see STOCK EXCHANGE.

Execution, in law, the process by which a judgment is enforced. The following are the main methods.

(1) *Writ of fieri facias* (Lat. do you cause to be done), generally abbreviated to *fi. fa.*, an order addressed to the sheriff authorising him to seize and sell sufficient of the judgment debtor's goods and chattels to satisfy the amount of the judgment, together with interest at 4 per cent. The wearing apparel and bedding of the debtor and his family, and the tools and implements of his trade, are exempted from seizure up to the value of £5.

(2) *Writ of elegit* (Lat. he has chosen). A writ authorising the sheriff to deliver to the judgment creditor all land, including leaseholds, legally in the possession of the judgment debtor, thereupon the judgment creditor becomes tenant by *elegit* for a period long enough to enable the debt and costs to be paid off, or he may apply in the Chancery Division for an order for the sale of the land.

(3) *Garnishee order*. Debts due to the judgment debtor cannot be seized under a writ of *fi. fa.*, but may be attached by means of garnishee proceedings. A garnishee order nisi (i.e. provisional) is served on the judgment debtor and his debtor, called the garnishee, calling upon the latter to show cause why he should not pay to the judgment creditor the debt owed to the judgment debtor. If the garnishee disputes the debt, the question of his liability will be tried and the order nisi made absolute or rescinded.

(4) *Charging order* An order charging the stock or shares belonging to the judgment debtor it must be served on the company whose stock or shares are to be charged and prevents the debtor from transferring such stock or shares until the debt is paid and the debtor discharged. The creditor may in addition obtain a *stop order* on the dividends or interest payable to the debtor or he may obtain an order for the sale of the stock or shares.

(5) *Receiver* Where the debtor has an equitable interest which cannot be taken in execution by any of the above mentioned modes an order may be obtained appointing a receiver to receive the debtor's interest in the property in satisfaction of the judgment. This is called equitable execution.

(6) *Writ of possession* An order authorising the sheriff to seize the debtor's land but only applicable where the action has been one for the recovery of that land similarly the recovery of a chattel may be enforced

by a *writ of delivery* by which the sheriff is ordered to seize the defendant's lands and chattels until he delivers the particular chattel.

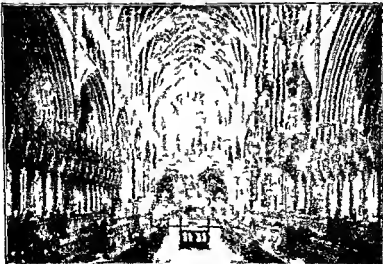
(7) *Attachment and Committal* The remedy for contempt of court (*q v*) by disobedience to its orders it is available where the defendant has disobeyed a judgment to do some specific act other than to pay money or to abstain from doing some act.

(8) *Sequestration* This is an additional remedy for contempt and results in the seizure of the rents and profits of the defendant's lands as well as of his goods and chattels by persons called sequestrators who may by leave of the court sell the personal property and pay the proceeds into court to be dealt with as the court may direct. See also DISTRESS.

Executors see PERSONAL REPRESENTATIVE.

Exequatur document issued by the Head of a State granting recognition to a foreign consul appointed thereto.

Exeter county town of Devon here



The Choir Exeter Cathedral.

on the R. Exe, near the estuary, with which it is connected by canal. It is an important railway junction and market. The chief industries are iron-founding, paper-making, cider- and beer-brewing. The old woollen industry has entirely disappeared. Exeter is also a cultural centre, its University College of South-West England (1922) being affiliated to Oxford and Cambridge. The town contains many Roman remains, a cathedral, chiefly of Gothic style, a Norman castle, and a fine library with many valuable old manuscripts.

Exeter arose as a Roman town, founded on an earlier British site. It was the scene of much fighting with the Danes, and was taken by William the Conqueror. It was given a Charter by Henry I which made it practically the equal of London. A number of powerful guilds grew up there. Pop. (1931) 66,039.

Exeter, Earl, Marquess, and Duke of. The 1st Duke of Exeter was JOHN HOLAND (c. 1352-1400), half-brother of Richard II. He was Chamberlain of England, and was created duke in 1397. The title of marquess was bestowed in 1523 on HENRY COURTENAY (c. 1496-1538), Earl of Devon, executed by Henry VIII. THOMAS CECIL, 2nd Lord Burghley (1542-1623) was created Earl of Exeter in 1605, his descendant HENRY, 10th Earl (1754-1804), becoming 1st Marquess (new creation) in 1801. The present, the 5th Marquess, is WILLIAM THOMAS BROWNLOW CECIL (b. 1876), his son and heir being LORD BURGHLEY, the British athlete and M.P.

Exhibition, a display of goods for the encouragement of trade, supplemented with public amusements and sights, a development of the mediæval trade fair. A series of exhibitions arranged by the art factories of France were held between 1798 and 1806, and the growing international trade of the 19th cent. rapidly increased the size and scope of such displays. Exhibitions assumed national importance, and in 1851 an

international exhibition, held in Hyde Park, in a building afterwards known as the Crystal Palace, attracted 1 million visitors. Successive exhibitions were held in Paris in 1855, 1867 (for which the Trocadero Palace was built), 1889 (for which the Eiffel Tower was built) and 1900. The latter had the largest attendance ever recorded at an exhibition—39 millions. Important exhibitions were also held at Vienna in 1873, at Philadelphia in 1876, at Chicago in 1893, and at St. Louis in 1904, the receipts of the latter amounting to nearly £10 millions.

Since the World War the number of exhibitions has been fewer, but the scale as great as ever. The British Empire Exhibition held at Wembley in 1924-5 demonstrated the industry and resources of the Empire, and was attended by 27 million people. In 1925 a special exhibition of Decorative and Industrial Arts was held in Paris, and in 1931 a huge French Colonial Exhibition on the Wembley plan. A remarkable World's Fair held at Chicago in 1933 to celebrate a centenary of progress was opened by the harnessing of a ray of light from the star Arcturus, which began its journey at the time of the previous exhibition of 1893.

Very few exhibitions pay their way, and the loss borne by the State is regarded as a legitimate investment in the interests of trade. Large numbers of manufacturers and traders co-operate and receive orders.

Ex-libris, see BOOK-PLATE.

Exodus, Book of, in the Old Testament, gives an account of the history of Israel from Joseph's death to the 2nd year after the Israelite exodus (q.v.) from Egypt. It includes some of the Hebrew moral codes, e.g. the Decalogue (q.v.).

Exodus, The, the migration of the Israelites under Moses from Egypt to Palestine, recorded in the Bible in the books Exodus to Joshua. Whether this record is historical or not is a disputed question, as the biblical narrative has not been corroborated.

by Egyptian records. There are however a number of Egyptian parallels regarded by historians as not improbably associated with the narrative as described in the Bible.

Exogamy, see TOTEMISM

Exorcism, see WITCHCRAFT

Expansion, see HEAT METALS

Expeditionary Force a military body sent abroad to fight as applied in the World War to that sent by Great Britain to France and Belgium in 1914 (B.E.F.) and by the U.S.A. to France in 1917 (A.E.F.)

Expert, a person having specialised knowledge by reason of his profession in law witnesses who give evidence upon matters within their professional knowledge as distinct from the particular questions of fact arising out of the case e.g. doctors as to the effect of drugs etc.

Exploration Little of the world was known to the ancient civilisations of the Mediterranean and the river valleys of Mesopotamia. War and commerce extended their knowledge. The Phoenicians explored the coast of Africa (c. 600 B.C.) and according to a doubtful legend mined tin in Britain. Wars brought Egypt and then Greece into touch with the empires of Mesopotamia and the armies of Alexander the Great penetrated as far E. as the Indus.

Under Rome the limits of the Empire were pushed steadily outward. By some however it is held that these explorations were more in the nature of rediscoveries. From archaeological finds it has been possible to piece together a sort of provisional network of ancient trade routes along which commodities passed from one part of the known world to another. There is no doubt that from time immemorial merchants had found a way through the primeval European forests to the far N. whence came the Balkan amber so highly prized that the Arabian frankincense passed by stages across the Red Sea or over the desert routes to Egypt that from far off China the caravans connected up

with Central Asia and Persia to bring the precious silks to Tyre on the edge of the Mediterranean and thence to the far flung network of the Phoenicians. It is likely however that the geographical knowledge of the merchants was a knowledge restricted to the roads and the caravan routes and carried with it little of that detail and understanding of the various hinterlands which the Romans later made their own.

Under Rome a period of systematic exploration set in. Hand in hand with the expansion of the Empire went an expansion of geographical knowledge. Europe was largely explored and a system of military maps showing mile stones was drawn up.

With the fall of Rome the unity of civilisation was shattered. Saracen conquests cut off Africa from Christian Europe which under Charlemagne became less centred on the Mediterranean. Contact with the E. Roman Empire was lost. During these Dark Ages voyaging continued in the N. The Vikings forced out of their native habitat by pressure of population voyaged forth in search of new lands for pillage or settlement. It is during these voyages that they are recorded to have founded settlements on Greenland (c. 1000 A.D.) and reached land to the W. believed to have been Newfoundland and possibly the coast of North America. These discoveries gave rise to a tradition that somewhere to the W. there lay desirable territory. In the Middle Ages the world was still largely the narrow world of the Ancients though the limits were being steadily pushed back. The centre of civilisation was no longer Rome and Italy. The towns of Germany and the Low Countries carried on a flourishing trade, the ancient trade with the Baltic countries and Muscovy which had from ancient times paved by the old routes to S. Europe and Asia Minor was drawn into direct contact with Central Europe and the proselytising zeal of the Teutons combined with commercial

ambition brought the lands of the N.E. Baltic into the orbit of civilisation.

The Hanseatic League (q.v.) traded with what are now the Baltic States. The Teutonic Knights defeated the heathens and converted them to Christianity. The barriers imposed to the E. by the Saracens and Tartars were occasionally pierced and areas well known to the Ancient World became variously known by the Middle Ages. Several travellers penetrated into the East and returned with accounts of their voyages. The most notable were John of Pizar de Carpini and Marco Polo. The former, sent by Pope Innocent IV. as ambassador to the Tartars then attacking Russia, penetrated as far E. as Karakum in Mongolia. The latter in 1271 journeyed for trading purposes through Palestine and Persia until he reached China, where he spent 17 years in the service of the Emperor. On his return journey in 1292 Marco Polo passed through the China Sea and the Indian Ocean, up the Persian Gulf, through Persia to Trebizond, and so to Venice.

The advent to power of the Ottoman Turks cut off trade routes with the East. At the same time the improvements in navigation and in the use of the compass made maritime voyages safer. The possibility of adventuring across unknown seas instead of hugging the coast-line opened up new avenues for exploration. Trade with the E. Indies and with India was for long the main objective, and a route was sought by sailing S round Africa. The Portuguese led in this effort. By 1480, settlements had been made in the Canaries, the Madeiras, and the Azores, and W. Africa had been explored almost to the Equator. Meanwhile, projects were mooted to reach the E. Indies by sailing W. Geographers were beginning to think of the world as a globe. Popular hostility to this conception delayed exploration W., until in 1492 Columbus managed to overcome opposition, sailed across the Atlantic and reached the W. Indies, thinking them to be a

part of the E. Indies. His voyage was continued and later supplemented by the N. by John Cabot, and on the S. by Amerigo de Vesputi, who gave his name to America (see SOUTH AMERICA). In 1497 Vasco da Gama navigated the Cape of Good Hope and sailed up the E. coast of Africa to Mombasa. The work of these great pioneer explorers was filled in in detail by traders and missionaries. The leaders in this movement were Portugal and Spain, who divided the new world between them under the authority of the Papal Bull of Demarcation of 1493, supplemented by the Treaty of Tordesillas in 1494.

The circumnavigation of the world by Magellan in 1519 brought Eastern and Western exploration into perspective. He sailed round S. America through the straits named after him, and in a journey marked by privation crossed the Pacific to the Philippines, thence to the Moluccas, across the Indian Ocean, and home to Lisbon via the Cape of Good Hope. Drake's voyage round the world is notable, in that it marked the emergence of England as a maritime power, soon to be of great influence in furthering exploration. Desire for trade, national rivalry, and a longing for loot drove the British on to attempt other routes to the East. The W. route by Magellan Straits or Cape Horn, and the E. via the Cape of Good Hope were dangerously near Spanish and Portuguese settlements. Attempts were made to find passages to N.E. and N.W., and thus opened the long chapter of polar exploration. These attempts produced like fruit for nearly two centuries (see ARCTIC AND ANTARCTIC REGIONS). Their motive became less and less that of trade, more and more that of adventure and, later of scientific discovery. The 15th and 16th cents., the great age of exploration, altered completely the map of the known world. Except for Australia and the Far East, the coast-lines of the world were roughly known. These discoveries changed the history of civilisation. The trade of the world began to follow the long sea routes—E.

via the Cape of Good Hope and Cape Horn to the Americas across the Atlantic. The maritime countries—Portugal Spain England and Holland—rose to power. The last two were close to the old routes near Flanders a centre of medieval trade and to the new. The discovery of silver in Mexico had a lasting influence on the political and economic development of Europe. The rise of prices through the introduction of great quantities of silver into Europe profoundly affected the medieval economic system.

The next two centuries—17th and 18th—were notable for the continuation of this maritime exploration and for the beginnings of land exploration. Trading companies such as the East India Company (q.v.) extended their operations and increased geographical knowledge. They penetrated inland as in India and America but kept within reach of sea or river communications. A new continent was discovered by Dampier in 1698 but it was not until Captain Cook's voyages in the latter part of the 18th cent. that anything more was discovered about Australia and the South Sea Islands. In Asia Russia had begun her E. march. European Powers had continued to acquire colonies. England in India N. America and various islands as often by conquest from existing European possessors as by exploration. Spain and Portugal feverishly explored their vast possessions for gold. The slave trade led to expeditions in W. Africa rarely penetrating beyond the coastal regions.

The 19th cent. opened a new chapter in exploration. The motives were now a combination of scientific discovery linked with colonial ambition trade and missionary endeavour. The beginning of the 19th cent. witnessed systematic efforts to open up the American African and Australian Continents to fill in the vast voids in the continental maps and penetrate particularly in Africa beyond the limited fringes along the coasts. Livingstone's great discoveries in

Africa included the Victoria Falls and Lake Nyasa and Mary Kingsley explored W. Africa. The Afghan War and the necessity for securing the N.E. frontier against possible Russian aggression led to discoveries there and to a series of important explorations in Central Asia and Persia by British officers. The opening of China Japan and partly of Africa was due mainly to commercial motives. Improvement in transport particularly in America threw open vast fertile areas to colonisation. There the settlers steadily pushed back the frontier crossed mountain ranges bridged rivers frequently moving far in advance of exploration.

The day of casual trade and pillage had gone and colonisation begun. Macdonald surveyed in Africa before laying a railway. Australians explored the interior to find sheep pasture land. The linking of economic and political motives in economic imperialism in the later 19th cent. further red African exploration as in the case of H. M. Stanley in the Congo basin. King Leopold II of Belgium financed Stanley's explorations which led to the setting up of the Congo Free State. German French and English Governments subsidised exploration in Africa with the object of creating markets and exploiting natural resources. The search for gold in America Africa and Australia was often successful though it frequently produced nothing but geographical knowledge.

Later 19th cent. exploration was carried on systematically to fill up gaps in geography. International expeditions attacked common problems adding to the knowledge of meteorology etc. particularly in Polar exploration where there could be little or no economic political or religious motive. The N. Pole was first reached by the American Farley in 1908 and the S. Pole by the Norwegian Amundsen in 1911. Scott reached the S. Pole shortly after adding much scientific knowledge. In Australia on the other hand the old motive of

adventure and curiosity was at work, and there were many individual expeditions, as that of Mr Stuart, 1868-9. The field is narrowing. The world has been mapped, and modern expeditions are fitted out to obtain exact information about climates, flora, and fauna of the different regions, and to fill in gaps in history from excavations of historic sites.

The 20th cent produced a new and invaluable instrument of exploration in the shape of the aeroplane and airship. These have enabled geographers to survey vast areas from above, and to travel great distances in spaces of time previously unimagined. By their means, the polar regions have been visited and mapped. Mt Everest has been flown over, and, particularly in Africa, extensive regions have been examined and mapped by the aid of the camera and a new technique that has been developed.

CONSULT *The Opening-Up of Africa*, by Sir H. H. Johnston, *The History of Exploration*, by Sir P. Sykes.

Explosives, compounds or mixtures of chemical substances, the atoms of which are capable of rearrangement with the evolution of energy, this rearrangement proceeding of itself when once started. Almost all practical explosives consist of compounds of carbon, hydrogen, and sulphur, combined or mixed with sources of oxygen in a concentrated form, such as liquid oxygen, nitrates, and nitro-groups.

Black powder, as gunpowder is technically termed, is a mixture of widely varying composition. A correct theoretical composition, to which English military powder approximated, is nitre 74.9 per cent, carbon 13.3 per cent, and sulphur 11.8 per cent. Such a mixture develops on explosion, mainly carbon dioxide and nitrogen, together with a little carbon monoxide. Black powder is made by very thoroughly mixing the ingredients and forming them into grains which are polished by means of a little graphite. The size of the grain determines the

rate of combustion. It is now hardly ever used except occasionally for blasting, and in the manufacture of fireworks (*qv*). Ammonium nitrate, NH_4NO_3 , is theoretically an explosive, since it can be decomposed into nitrogen, water, and nitric oxide (NO) with evolution of heat. It was, however, believed until the terrible disaster at Oppau in 1921, that it could not be made to explode when pure, although it had always been used as a constituent of other explosives. It is a valuable fertiliser, and a mixture of it with ammonium sulphate was made at Oppau on a vast scale for this purpose, the product being obtained in the form of a rock-like mass weighing several thousand tons, which was broken up for grinding by blasting. Although some 20,000 charges had been fired for this purpose without mishap, a devastating explosion finally occurred, over 500 people losing their lives, and nearly 2000 being injured. Ammonium nitrate, mixed with organic nitro compounds (*see below*), forms the main constituent of a large number of both military and blasting powders.

When nitric acid (HNO_3) is caused to act upon organic compounds containing the group OH , what is called *nitration* occurs. The elements of water are split off, and a nitro group (NO_2) is introduced. The first explosive of this kind was discovered by Pelouze, a Frenchman, in 1838, who acted upon cotton with nitric acid, thus preparing *nitro-cellulose* or *gun-cotton* (*see CELLULOSE*). Nitration can be carried, in the case of compounds containing several OH groups, to various degrees, and hence nitro-cellulose is made of various compositions according to the purpose for which it is required. A nitrating mixture of 1 part by weight of strong nitric acid with 3 parts of strong sulphuric acid (to absorb the water formed) is used, and the action takes only a few minutes, being conducted in lightly built sheds with the object of minimising the effects of an accident. In order that the product shall be safe, every trace

of acid must be removed but when this is done the product can be formed by high pressure into hard cakes and safely handled. A drawback to gun cotton is its extreme inflammability, which is not shared by many other explosives. Explosives of this type are not used like gunpowder by setting fire to them they are detonated that is caused to decompose very suddenly by exploding a small quantity of an auxiliary high explosive which is sensitive to heat or mechanical shock.

In 1817 Sobrero an Italian discovered nitro-glycerine formed by acting on glycerine with the mixed acids. This proved much more dangerous and difficult to handle than gun-cotton but nowadays it can be made sufficiently safe to be used as an ingredient in other mixtures being hardly ever used in its pure state. Nobel hit upon the plan of mixing it into a kind of putty with powders such as sawdust flour and the siliceous earth known as kieselguhr forming the substance *dynamite* and later the gelatinous mixture of nitro-glycerine and gun-cotton which forms the basis of so many explosives to-day. This mixture when detonated decomposes much more slowly than either of the constituents separately and hence forms the chief propellant used in modern ordnance. A small quantity of oil has to be incorporated with the mixture vaseline being commonly used. A volatile solvent generally acetone is used to assist the process this is the British military propellant *cordite*.

Smokeless powders are now made of many other compositions as for example with additions of nitro-aromatic bodies such as *trinitrotoluene* familiarly known as *TNT*. This is a derivative of toluene $C_6H_5CH_3$ the formula of TNT being $CH_3C_6H_2(NO_2)_3$. Its use as an explosive was developed before the War by the Germans and copied by ourselves after its success had been proved. The British high explosive

of this character previously in use was known as *lyddite* a derivative of phenol or carboic acid C_6H_5OH commonly known long before its use as an explosive as *picric acid* $C_6H_2(OH)(NO_2)_3$.

A characteristic of every explosive is the rate at which the explosion wave proceeds through the substance when once started. There is no sharp line of demarcation between any self-burning mixture such as may be used in a firework in which the action proceeds from point to point quite slowly and gun-cotton and nitro-glycerine which explode with extreme rapidity. The effect of extremely rapid explosion is however to produce a shatter effect called by the French *brisance* which renders such explosives useless for propelling a bullet or shell which has to be started up from rest or for blasting where the object is to remove rock or other material in large masses. When this is not the case as for instance in shooting oil wells that is to say loosening up the oil bearing strata nitro-glycerine is often used pure sometimes in enormous charges. The usual method of causing such substances to explode is by what are called *initiation explosives* the one chiefly used being *fulminate of mercury* (*qu*) *lead azide* also is used. These explode violently when struck and the explosion detonates the main explosive. For blasting a great number of different explosives are employed even including black powder frequently made with sodium nitrate. *Dynamites* already referred to are now generally made with wood meal as a basis. *Ammonia dynamites* contain ammonium nitrate and *gelatine dynamites* gun-cotton. What is called *blast gelatine* has a similar composition to cordite, but contains chalk. It has a very powerful and concentrated action which is used in certain cases. *Gelignite* consists of nitro-glycerine potassium nitrate and a little wood meal.

An important new development con-

sists in using cartridges of pure carbon or other combustible substances, soaked immediately before use in liquid oxygen. The cartridge is then fired by detonation in the ordinary way. As regards safety, this method leaves nothing to be desired, because the substances before mixing are not explosives at all, and the liquid oxygen rapidly evaporates, leaving the cartridge as harmless as before. A drawback is that if insufficient oxygen is present, as when evaporation has taken place owing to delay in firing, carbon monoxide, an insidious poison, may be produced by the explosion, a very dangerous matter in a mine.

A recent development, which can hardly be classed with explosives, comprises a steel shell containing liquid carbon dioxide, which is heated very rapidly by means of a suitable mixture of the thermite type (*see* WELDING). Under the increase in pressure the steel shell is shattered, the disintegrating effect of this on soft material such as coal being very satisfactory. A great advantage is that no flame sufficient to cause explosion in a coal mine is produced.

CONSULT Arthur Marshall, *Explosives* (London, 1932).

Export of Capital. The export of capital means the investment by the nationals of one country in enterprises in another country. A country whose nationals lend more abroad than they borrow from foreign nationals is called a creditor country, and one whose nationals borrow more from foreigners than they lend to them is called a debtor country.

Before the World War the great creditor country with far and away the largest overseas loans was Great Britain. France, Germany, and Holland were also important creditor countries. The debtor countries were the United States (which since the War has become the second largest creditor country), Canada, Australia, and other parts of the British Empire, S. American countries, Russia, etc., etc.

British overseas investments were estimated at about £2700 millions in 1907, £3700 millions in 1913, and about £3400 millions in 1931. Every year between £90 millions and £190 millions were loaned by British nationals to foreign and colonial enterprises and Governments during the decade before the War.

France had foreign investments estimated at about 45,000 million francs (£1800 millions) in 1914; Germany about 25,000 million marks (£1250 millions) in 1914.

Great Britain lent chiefly to her colonies, S. America, and to the United States—i.e. to new countries where economic development was rapidly taking place. Nearly half of her foreign investments in 1913 were in railways, and about a quarter to Governments. France lent chiefly to Russia and other European countries, and her colonies; Germany to Austria-Hungary and S. America.

After the War the United States lent, in the 8 years 1922-30, £1450 millions abroad, chiefly to Germany and other European industrial countries, and also to S. American nations.

For a discussion of the importance of the export of capital in the *BALANCE OF PAYMENTS*, *see* article of that title.

Expressionism, see PAINTING.

Expropriation, dispossession; an owner of his property wholly or in part, term generally limited to seizing for State purposes.

Extensometer. An apparatus employed for measuring the strain produced in material when stressed. The principle usually employed is to attach to the material at two points as far apart as convenient a pair of indicating devices, the distance between which can be measured accurately, usually by means of a microscope or the deflection of a mirror. Recently, forms of extensometer have been developed which can be attached to a structure such as a steel bridge, and will continuously indicate and record the strain in the metal at the point of

attachment Devices of the kind are frequently required where the subsidence of bridge piers or buildings is suspected See also STRENGTH OF MATERIALS

Extradition, the delivery of a person accused or convicted of a crime to the State on whose territory the crime was committed by the State on whose territory he happens to be Such delivery is not a duty but a matter of comity or is dependent on a special extradition treaty Extradition of ordinary criminals occurred but rarely before the 18th cent though heretics and political fugitives were frequently surrendered Since then the practice has undergone a change particularly as a result of improved travelling facilities which enabled many criminals to escape At the present day there is scarcely a single crime of any importance which is not extraditable in almost every country The great exception is that of political crimes an exception first introduced by Belgium in 1833 It was not until 1870 that Great Britain reluctantly admitted the necessity for extradition The exception of political crimes is now to be found in most extradition treaties though limited by the so-called *non bis in idem* clause By this clause introduced by Belgium in 1836 following an attempt upon the life of Napoleon III it was enacted that murder of the head of a foreign Government or of a member of his family should not be considered a political crime The clause has been adopted by all the European countries except Great Britain and Switzerland

Extraterritoriality or *Exterritoriality* in international law the condition of being considered as outside the country in which one resides and so outside the jurisdiction of its courts Extraterritoriality is the privilege of all duly accredited and received diplomatic envoys and is based on the principle that they must for the purpose of fulfilling their duties be independent of the control of the receiving State It involves immunity of domicile the so-called *FRANCHISE DE*

L'HÔTEL a right which until the 19th cent extended to the whole quarter of the town in which the residence was situated No person and no officer of the receiving State can enter the residence of the envoy without his permission though the State need not passively bear abuse of the privilege e.g. if the envoy has given shelter to a fugitive criminal and refuses to surrender him the house may be surrounded by soldiers and the criminal taken by force A famous example is that of Sun Yat Sen in 1896 a political refugee from China who was induced to enter the Chinese Legation and there kept detained until the British Government demanded his release The second privilege is immunity from criminal or civil process unless his State waives the privilege Abuse of the privilege will lead to a request for his recall Thirdly a diplomatic envoy cannot be forced to appear in court as a witness

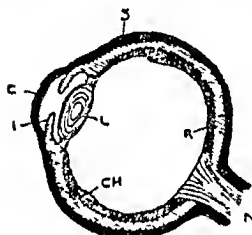
He is exempted from direct taxation and frequently from payment of customs duties on goods intended for personal use He is not subject to the police of the receiving State though expected to comply voluntarily with such orders as do not restrict him in the exercise of his duties or are of importance for the general good order of the community He has the *droit de chapelle* i.e. the right of having a private chapel for the practice of his own religion Lastly he has such civil and criminal jurisdiction over the members of his retinue as his State may delegate to him Formerly an ambassador's privilege in this respect extended even to the infliction of capital punishment

Extreme Unction, a sacrament of the Roman Catholic Church consisting of the anointing with oil of a sick person whose death is imminent The sacrament which is founded upon Chap v verses 14-15 of the Epistle of St James is a symbol of the forgiveness of sins and has been in general use in the Western Church at least since the 8th-9th cents

Eyck, Hubert and Jan Van, see VAN Eyck

Eye, market town in Suffolk, 5 m S of the Norfolk border. There is a small ironworks and a brewery, and a weekly market dealing with stock and agricultural produce. The castle ruins are the chief historical remains in the neighbourhood. The church belonged to a Benedictine Priory, and according to Leland, once owned the "Red Book of Eye," a copy of the Gospel, at one time the property of St Felix. Pop (1931) 1733.

Eye, a name loosely applied to any definite area of an animal body sensitive to light-rays. It ranges



Eye (in Section)

- C = Cornea
- CH = Choroid
- I = Iris
- L = Lens
- N = Optic Nerve.
- R = Retina.
- S = Sclerotic

Many animals without eyes distinguish light from darkness by their skin, as the earthworm. Many of these respond to sudden exposure to light or to a passing shadow as quickly as those furnished with so-called eye-spots. One of the simplest types possessing an eye-spot is the flagellate Protozoon *Euglena* (q.v.), which has a patch of red pigment close to the base of the flagellum. In the jelly-fish, simple eyes, called ocelli, consisting of sense-cells, pigment, and sometimes a lens, are frequently developed on the margin of the umbrella. Similar simple eyes may or may not be developed in fairly closely related animals, and are of no special zoological interest. In the common starfish, for instance, one

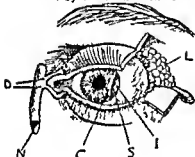
in structure from a mere spot of pigment to a complex mechanism comparable to a camera in having a lens and a sensitive surface, and being capable of forming a definite image of surrounding objects.

eye, tinted red, is situated at the top of each arm, joined to the long nerve which ends there, and in some sea urchins there is a circle of five eyes, round the centre of the upper side of the body. In a bristle-footed sea worm (*Nereis*) there are two pairs of simple eyes, consisting of a cup-shaped retina and a gelatinous lens, at the front end of the body. This simple type of eye is not uncommon in Molluscs, in which eyes, or at least definite areas sensitive to light, are present in most species, and may occur on almost any exposed area, even on the shell in *Chiton* (q.v.), or scattered over the mantle in oysters and corals, which respond to passing shadows by closing their valves. In the scallop, better developed, gem-like ocelli are arranged along the edges of the mantle. In the Gastropods there are generally two eyes on the head, which may be mere sensitive pits as in the limpet, or more advanced as in the snail, in which the pit contains an oval lens and is closed by a "cornea." In the snails and slugs the eyes are at the tip of the long horns, and can be folded in when the horns are withdrawn. The *Nautilus* has a simple, cup-like eye like that of the limpet, but in the cuttlefish and squid, which have excellent vision, the eyes are large, superficially like those of a fish, and quite as elaborately constructed.

In the Arthropoda eyes are typically well developed and are of two kinds, simple eyes or ocelli, with a single lens, and compound eyes with many lenses, both sometimes occurring in the same animal.

In the lower Chordates there are no true eyes, the visual organs in the sea squirts and the lancelet being simple pigment spots sensitive to light; but in the vertebrate chordates a pair of eyes, unless adaptively lost as useless, is always present. Fundamentally, they are similar in structure throughout the different classes. Each typically consists of a spherical capsule, the walls of which are composed of 3 layers surrounding a cavity filled with

a gelatinous fluid the vitreous humour. The outer layer or sclerotic is thin and cartilaginous but in the front of the eye it is modified to form a transparent area the cornea through which light passes into the interior of the eye. The cornea is covered externally by very thin delicate skin the conjunctiva. The middle layer or choroid is a vascular black opaque membrane which close to the point where the cornea begins passes into the iris. The iris forms a curtain behind the cornea and surrounds a central orifice the pupil which can be enlarged or diminished by the contraction of the



- Th. L. y. and Ducts
 C = Cornea.
 D = Tear Duct.
 I = Iris.
 L = Lacrymal (tear) Gland.
 N = Nasal Duct.
 S = Sclerotic part of Eyeball.

muscles of the iris for the admission of more or less light. The inner surface of the choroid especially at the back of the eye is lined with a silvery membranous tapetum. The innermost layer is the retina the only part of the eye sensitive to light being supplied with the terminal branches of the optic nerve which enters the eye from behind. The last structure of importance in the eye is the lens a solid spherical translucent body suspended in the fore-part of the eye immediately behind the pupil. The space between the lens and iris behind and the cornea in front is filled with a liquid the aqueous humour. Light

which passes through the cornea and aqueous humour enters the lens which focuses it on the sensitive part of the retina. The eye at least in the land forms is kept moist by the secretion of glands the lacrymal or tear gland on the outer surface of the socket being the principal one. The eye usually is protected by two or three lids and is moved and kept in place by muscles attached to the wall of the orbital cavity of the skull.

In the fishes cornea is flat as in other aquatic Vertebrates e.g. the whales the lens is large and bulges from the pupil there are no special moistening glands movable eyelids are generally absent although present in the Plasmobranchs (sharks etc.) and in many fishes including the bony forms the lens is attached to the back of the eye by a thin band of muscular tissue which rises from the choroid close to the entrance of the optic. The eyes differ somewhat in details in different classes. In the frogs, toads and newts lids are present but there are no lacrymal glands. Most Reptiles have lids but the peculiar glassy stare of a snake's eye is due to their absence. Lacrymal glands are present and in tortoises and lizards the sclerotic is strengthened by bony plates.

The eyes of Birds are the most highly developed optical organs in the vertebrates and are distinguished by the prominence of the cornea the large chamber for the aqueous humour and the expansion of the inner position of the ball which is strengthened by bony plates. There is also a flap called the pecten or comb found in a more rudimentary state in Reptiles projecting into the vitreous humour from the back of the eye. This structure is not represented in the eye of Mammals but as in the Birds and Reptiles three lids are usually present, although the third or inner lid is reduced to a mere vestige in man and monkeys. In this class the eyes differ greatly in development and position. In borers they are usually suppressed to a

greater or less extent. Generally they look more or less sideways, but in monkeys and man they look straight forward, so that the head has to be turned to see an object at the side.

In these Mammals, which are less dependent on scent than others, vision is more precise and of longer range. The vertebrate eye is developed from three tissues, but the light-sensitive portion arises from the brain as a hollow outgrowth, which assumes the shape of a goblet called the optic cup. From this cup is derived the retina with its visual elements, the rods and cones, also a layer of pigmented cells associated with those structures, and, in front, the iris, and from the retinal cells behind, the fibres of the optic nerve extend inwards along the stalk of the cup to the brain.

The lens, on the contrary, arises as an infolding of the ectoderm, opposite the optic cup. This infolding becomes shut off from the exterior, and is fitted to the margins of the optic cup. The third tissue concerned is the mesoderm, which gives rise to the choroid and sclerotic coats, the cornea, the vitreous humour, and the eye muscles.

When light passes into the eye, it is focused by the lens, operated by muscles around it which adjust its focus, and falls upon the sensory cells lining the cup. These pass the stimulation along the nerve fibres into the optic nerve. These fibres conduct impulses from the left side of each eye to the left side of the brain, and impulses from the right side to the right side of the brain. In this way, rays of light from the right side of the body, that is, in the right visual field, enter the two eyes, and fall upon the left side of each, and are conducted thence to the left side of the brain. Hence it will be clear that, if the left optic nerve is damaged by disease or injury near the point where it leaves the brain, the patient will suffer from complete blindness to everything on his right side. But if the optic nerve is damaged near the eye, he will suffer merely from the

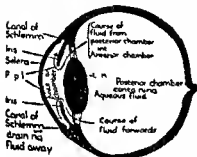
disuse of one eye. The other eye will see both sides of the body, as before. In man, the eyes are both in front of the head. Thus, when he wishes to focus an object, he must squint slightly, a movement performed by special muscles which focus automatically, and make the squint most acute for near objects. Man can thus estimate distance automatically, provided he has the use of two eyes. This ability is known as stereoscopic vision. If one eye is lost, however, this ability to judge distance is lost also. Hence a man who has recently lost the sight of one eye, is unable, for example, to pour tea from a teapot into a cup with any degree of precision.

The muscles, tear-glands, eyelids, and the bony socket of the eye are accessory organs, which do not form part of the visual sense organ, but are nevertheless essential for the proper performance of its functions. The muscles of the eye are conveniently arranged into two groups, one inside the eye, arranged round the lens so that, in contracting, it alters the size of the lens and thus controls its focal length. In old people this group of muscles tends to become worn out, and the focus of the lens permanently shortened. Thus, to focus light from objects on to the retina, those objects have to be held close to the eyes. There may be a permanent condition of short-sightedness, or one in which the lens focus is too long, known as long-sightedness. In both cases, auxiliary lenses, e.g. spectacles, when placed in front of the eye will correct the focus.

The iris also is composed of circular muscles, which by their action enlarge or contract the pupil, thus controlling the amount of light that enters the eye. The eyes in a whale are moved by muscles passing from the outer surface of the ball to the back of the orbit, and the movement of the eye is facilitated by lubrication of the secretion of the lacrymal gland. Normally the secretion passes down a

duct into the nose but when excessive it may overflow as tears. The tears combine with the eyelids to keep the eye from injury by foreign particles.

Two common diseases of the eye are *Cataract* and *Glaucoma*. *Cataract* (q.v.) is produced by opacity of the lens which prevents light entering the eye. Complete blindness may eventually result. *Glaucoma* is a condition of increased tension of the fluid in the



Section of Eye Exhibiting Glaucoma.

globe of the eye. This fluid is continuously being formed and drained away. If there is any blockage in the draining mechanism the fluid accumulates in excess and eventually the pressure produced may do irreparable damage to the eye.

Eyebright, a small plant of the *Scrophulariaceae* 2 ft in high with deeply cut leaves and loose spikes of numerous white or purplish flowers with yellow patches. On the mountains and near the sea the stem is scarcely branched and the leaves are fleshy but in rich soil it assumes the habit of a minute shrub. The roots are said to be purgative on grasses. The infusion of this plant makes a useful eyewater.

Esra, a small S. American wild cat exhibiting two colour phases long regarded as representing distinct species: a tawny phase being known as the *vra* and a dark grey phase as the *yaguarond*.

Eyre, Edward John (1815-1901)

British colonial governor who explored the N. part of the newly colonised S. Australia; his report resulting in the opening up of the land route between Adelaide and W. Australia. Lake Eyre, S. Australia was named after him. He was Governor of St. Vincent 1854-60 and was made Governor of Jamaica 1884. After his vigorous suppression of a negro revolt in Jamaica 1840 he was suspended and retired. An investigation was made by a committee headed by J. S. Mill, opposed by a committee including Carlyle and Charles Kingsley. The enquiry caused much excitement.

Eyres Monsell, Sir Bolton (b. 1881) Conservative politician. He joined the Navy in 1896 and retired from active service in 1906, rejoining in 1914; he rose to the rank of commander. He became a Unionist Whip in 1911, Treasurer of the Royal Household in 1916, a Civil Lord of the Admiralty in 1921 and Financial Secretary to that body in 1923. In this latter year he became Conservative Chief Whip; a post he held until 1931 when he was appointed First Lord of the Admiralty in the National Government.

Ezekiel, a Hebrew prophet who began to prophesy during the Babylonian captivity; his sayings being recorded in the Book of Ezekiel. After attributing the downfall of Judah to the national wickedness, and prophesying the punishment of its oppressors, he consoles the Jews with the promise of return to their land and the rebuilding of the Temple.

Esra, a Hebrew scribe exiled in Babylon who led a party of fellow exiles back to Palestine c. 488 B.C. Authorship of the Book of Esra and by some also Chronicles is attributed to him.

Esra, Third and Fourth Books of (or 1st and 2nd Esdras in the Greek) two books in the apocrypha of the Bible. Esra 3 deals with the decline of Judah and the Babylonian exile. Esra 4 is an imitation of the Hebrew prophets written in a spirit of

simism after the destruction of Jerusalem, it deals mainly with the Resurrection and the Judgment. Probably written in the 2nd cent A.D., it has influenced Christian eschatology (q v)

Ezra and Nehemiah, Books of, two

books of the Old Testament, a continuation of Chronicles, and probably written by the same hand. They continue the history of the Jews until after the return from Babylon and the beginning of the re-building of the Temple.

F

Fabrics

Federick William (1814-1893) English Roman Catholic priest and hymn-writer. He was influenced by the Englishman and became Roman Catholic in 1845 presiding over the Oratory 1845-63. He is known as a writer of hymns. *See Pilgrims of the Night* and *Bless us ere we go*.

Fellowship An intellectual society founded in 1887 by John Addington Symonds (Lord Passfield), Beatrice Webb, Sidney Webb, and George Bernard Shaw among others. The influence of the body in the nineties was very great. *See Fabian Essays* was an important book of Socialist thought. It followed the Roman general Cunctator (qv) who was famous for his policy of wearing down by delaying tactics rather than offensive action. *See also*

Quintus, Cunctator (d. 206 BC) Roman soldier and statesman. He was consul, censor, ambassador to Carthage, and in 217 BC was appointed to lead against the Carthaginian general Hannibal. His policy of delayed defence—his nickname the delayer—was criticised among his colleagues for the Roman defeat at Cannae. He was reinstated and won back Tarentum. He opposed Scipio's policy in Africa.

Quintus (d. c. 254 BC) a Greek Roman history. He is the legendary foundation of the Punic Wars fragments of which earned him the title of the father of Roman history or the distinction between the real and Allegory. *See*

the famous and probably the

first of all fabulists was Aesop (qv) in the 6th cent BC and after him the Latin Phaedrus (qv) and the French La Fontaine (qv). In English Dryden, Prior and Gay have written fables in verse.

Fablia [FABLIÖ] a form of early French literature consisting of short versified tales comic in spirit and intended primarily for recitation. They came chiefly from N and NE France and were mostly written between the close of the 12th cent and c 1340. They caricatured every class and subject but particularly women.

Fabre d'Eglantine, Philippe François Nazaire (1750-1794) French revolutionary author. He was secretary to Danton and a member of the Cordeliers and Jacobin clubs. His best known play *Philinte* (a sequel to the *Misanthrope* of Molière) attacks the aristocrat. His song *Il pleut il pleut bergère* was popular with the revolutionists.

Fabrizio, Francesco Di Gentile Da (c 1370-1450) Italian painter born at Fabriano about the middle of the 14th cent. Most of his work was done in Florence and is typical of the early Umbrian and Siennese schools. It was marked by rich colouring. Two of his best known pictures are the *Adoration of the Kings* painted for the Church of the Holy Trinity in Florence and the *Madonna with Saints* in the Berlin Museum.

Fabricius, Hieronymus d'Aguespen (1537-1619) Italian anatomist and founder of modern embryology. He studied at Padua under Fallopius (qv) whom he followed as teacher of anatomy and surgery. His experiments on the veins influenced his great pupil Wm Harvey. He wrote numerous medical works, a collected edition of which was published in 1687.

Fabrics, see Textiles

Fabritius, Carel (c. 1614–1654), Dutch painter, was the pupil of Rembrandt and the master of Vermeer of Delft. His portrait of a soldier and that of a musical instrument dealer in the National Gallery are good examples of his work. He was killed in middle life in an explosion at Delft. Existing specimens of his work suggest that he might have developed into one of the most important painters of the Dutch school.

Fabyan, Robert (d. 1513), English historian, Sheriff of London, 1493, defended Newgate against the Cornish rebels, 1498. His writings, *The Concordance of Histories, New Chronicles of England and France*, deal with events up to the death of Henry VII.

Face Value, the amount appearing upon the face of a bank-note, coin, bond, share certificate, debenture, or other negotiable instrument. Face value is distinguished from market value (of a share certificate, etc.), and from intrinsic value (of a coin). The former is that quoted for the security on the stock exchange, the latter the value of the precious metal contained in the coin. For example, the intrinsic value of the gold in a sovereign (face value £1) may be 30s. in paper money, while that of the silver in a shilling may be only 2d.

Faction. A political body, especially in the uncomplimentary sense of one which puts its party objects above the good of the State and works for them by unscrupulous means.

Factory Acts, see LABOUR LAW.

Factory Inspection. The evil conditions of labour in the early factories have been greatly bettered, not only by voluntary improvement but by legislation. Various Acts were passed from 1802 (the *Morals and Health Act*) onwards. In 1819 the *Cotton Mills Act* laid down a minimum age for the employment of children and a maximum of 72 hours a week, and many similar regulations relating to women's labour, accidents, conditions, hours, etc., followed. These

only be enforced by a system of inspection, inaugurated as early as 1825 by Lord Ashley, who board of skilled inspectors with powers. In 1893 women were first appointed. The *Factories Act* of 1901 provides for appointment of inspectors and down their powers and duties, at same time giving right of entry of inspection to local authorities. principal duties of the inspector are to see that labour legislation is complied with in all particulars.

Factory System, see INDUSTRIAL REVOLUTION, INDUSTRIAL ORGANISATION.

Facula, see SUN.

Faculty (ecclesiastical law), licence which must be obtained from the Chancellor of a diocese before new ornaments are introduced into a church or structural alterations undertaken.

Faed, Thomas (1826–1900), Scots painter. Faed studied in Edinburgh, and became A.R.S.A. and R.A. His paintings were of a popular character, such as *Reading the Bible*, *Mitherless Bairn*, and *Faults on both sides*, examples of his work hang in the Tate Gallery.

Faenza, Italian town in Emilia, 30 m. S.E. of Bologna. Faience pottery, which takes its name from the town, was manufactured in the 16th and 17th cents., and is one of its industries. There is a famous museum of ceramics. Pop. 22,500.

Faerøe Islands (Dan. *Færøerne*), a group of islands in the N. Atlantic between Greenland and the S. of Sweden, belonging to Denmark. The surface is rugged, and the climate wet and cold. About 16 of the islands are inhabited. The main occupations are sheep-rearing, fishing, whaling, and some fowling. There is little agriculture, and the few domestic industries include spinning and weaving. The islands, settled by Norse explorers in the 8th cent., became Danish in 1380.

There is a movement to form a government. The capital is

is Thorshavn on Strömd Island
Area 550 sq m pop (1930) 24 000

Faesi, Robert (b 1883) German Swiss author wrote a tragedy *Opfer spiel* (1935) a comedy *Fassada* (1918) and a war poem *Aus der Brandung* (1917). He is Professor in Zurich University and has written several books of literary criticism.

Fafnir [FA HFNIR] a giant in Norse mythology who in the shape of a dragon guarded the treasure of the Nibelungs and was slain by Sigurd (in the *Nibelungenlied* Siegfried).

Fagan, James Bernard (b 1873) actor producer and dramatist. His best known play is *And So to Bed* (1906) which had a successful London run. *The Happy Island* (1913) *The Greater Love* (1907) and *The Impoverished Duchess* (1931) are other of his successes.

Faggoting see NEEDLEWORK

Faguet, Emile (1847-1916) French literary critic and historian wrote a series of books on French men of letters and a *History of French Literature from the 17th Century to our Times*.

Fahrenheit, Gabriel Daniel (1686-1736) German scientist became a resident of Amsterdam and there invented the thermometer which bears his name. He was the first to use mercury as an expanding medium in temperature measuring instruments and had his cal been more scientifically devised his instrument would probably never have been surpassed. Setting his zero at the lowest point to which the mercury sank in the winter of 1709 he produced an impractical scale with freezing point of 3° and boiling point -12° which is still in ordinary use in Great Britain except for scientific purposes.

Fahien (c. A.D. 400) Chinese monk and writer. He witnessed and described in his *Travels* Buddhist festival customs and beliefs encountered in Turkestan Afghanistan India and Ceylon whither he travelled from China via the Gobi Desert.

Falence see FARNIA.

Fainting see FIRST AID

Fairbairn, Sir William, Bart (1789-1874) Scottish engineer born at Kelso Roxburghshire apprenticed to a millwright 1804 and about that time made friends with George Stephenson. In 1817 he set up a business in Manchester experimented with iron ships and in 1835 established a ship-building yard at Millwall. He built the Conway and Menai tubular bridges in 1845 and made many investigations into steam boilers and metallurgy. He was elected President of the British Association in 1861.

Fairbanks, Douglas (b 1884) American film actor made his stage debut in New York in 1901. In 1915 he took up screen work and has starred in *The Three Musketeers* *The Thief of Baghdad* *Don Q* and *The Iron Mask*. He has also appeared in talking films including *Around the World in 80 Minutes* and *Mr Robinson Crusoe*. In 1920 he married Mary Pickford the world famous film actress.

Fairfax of Cameron, Ferdinando Fairfax 2nd Baron (1584-1648) English Parliamentary general. As M.P. he sided with Parliament against Charles I and when the Civil War broke out in 1642 became Parliamentary commander in Yorkshire. He gained victories at Hull Selby and Pontefract but resigned on the adoption of the Self-denying Ordinance 1645.

Fairfax of Cameron, Thomas Fairfax 3rd Baron (1611-1671) English Parliamentary general. He assisted his father Ferdinando Fairfax in his Civil War campaigns in the North and became commander of the Model Army 1645. Victorious at Naseby he then captured Oxford (1646) the Royalists' headquarters and Colchester in 1648. Fairfax resigned shortly after Charles I's execution, and in 1649 went to The Hague to assist Charles II to return. He was a benefactor of the Bodleian Library Oxford. Milton wrote a sonnet urging him to settle the political troubles of the time.

Fairway, the navigable channel for

entering and leaving a harbour, the normal route for ships in difficult and dangerous waters. In golf, the part of the course over which the drive is made, between the holes, so called because the ground is made specially smooth.

Fairy, a name given in English to an imaginary being of diminutive human shape. Fairies are immortal, are credited with magical powers over human destinies and with changing their shape and becoming invisible. The belief in fairies is widespread, and fairy-tales exist in every language of the world. There are good and evil fairies, land and water fairies, and those who inhabit mines and marshes. Elves, goblins, pixies, brownies, kelpies, fays, sprites, trolls, leprechauns, and dwarfs belong to the group, but their origin is lost in antiquity.

Fakir [fākēr'] a Hindu ascetic or any "holy man" in Islam. The term is used loosely in India for any member of the hordes of beggars or those who pretend to religious power.

Falcon, a name for several species of

strictly 'the name is applied to the species, commonly known as the peregrine, which nests on cliffs in various parts of Great Britain, but with several varieties is found almost all over the world. When hawking was a favourite pastime, this falcon was usually flown at rooks, game birds, or even herons.

Falcone, Aniello (1600-1665), Italian painter of the Neapolitan school, renowned as a painter of battle scenes. He also executed a number of frescoes of religious subjects in a realistic manner including a *Flight into Egypt*, now in the cathedral at Naples.

Falconer, Hugh (1808-1865), British naturalist and palæontologist, born in Scotland. He became surgeon to the E. India Company, and discovering fossils in the Siwalik Hills, produced a description of them entitled *Fauna Antiqua Sivalensis*.

Falconry, the training of hawks and falcons for use in the sport of hawking (q v).

Falguière, Jean Alexandre Joseph (1831-1900), French sculptor and painter, born at Toulouse, whose paintings, two of which, *The Wrestlers* and *Fan and Dagger*, hang in the Luxembourg, show the same vigour and animation as his sculpture. When Rodin's *Balzac* was refused by the Société des gens de Lettres, the commission was given to Falguière. His *Joan of Arc* and his *Triumph of the Republic* on the Arc de Triomphe are two of his best-known sculptures.

Faleri, Marino (c. 1274-1355) doge of Venice, repelled the Hungarians at Zara, 1316, and captured that city. Shortly after he became doge in 1354, the Venetian fleet was annihilated by the Genoese. This and other disasters led him to conspire against the nobles, in the hope of becoming prince of Venice. He was arrested by the Council of Ten, and executed.

Falkenhayn, Erich von (1861-1922), Prussian general. After serving in China, he became general and Prussian War Minister. He hastened Germany's declaration of war, 1914, and



Peregrine Falcon

medium-sized birds of prey distinguished from hawks by their longer pointed wings, which give them greater speed in flight. Usually and more

superseded von Moltke as Chief of Staff. He precipitated the first battle of Ypres and planned the offensives on Russia and Serbia 1915. Falkenhayn also proposed the attack on Verdun and as a result of its failure was replaced by Hindenburg. He commanded the 1916 offensive against Rumania and later commanded in Mesopotamia and Palestine. Author of *General Headquarters 1914-16 and its Critical Decisions*.

Falkirk, Scottish town of Stirling-shire W. of the Firth of Forth. It lies in a mining and agricultural district and is noted for cast iron goods and chemicals. Flour-milling, tanning and brewing are carried on. There are many Roman remains. Pop. 36,000.

Falkirk, Battles of (1) July 2, 1793, a superior force of English under Edward I. routed the Scots under Sir Wm. Wallace who fled. (2) Jan. 16, 1746, the Highland rebels of 45, under the Young Pretender, defeated the British under General Hawley.

Falkland, Lucas Cary 2nd Viscount (c. 1610-1643), English politician. Elected M.P. 1640, he became Charles I.'s Secretary of State. After vainly endeavouring to make peace between King and Parliament, he was killed at the battle of Newbury. Falkland was the friend of Ben Jonson, Suckling and Clarendon and was the author of some poems.

Falkland Islands, a British Crown colony in the S. Atlantic c. 300 m. E. of Magellan Strait, numbering about 100 islands of which only E. Falkland and W. Falkland are of considerable size. Total area c. 5600 sq. m. It is a seal and whaling centre; sheep-rearing is the principal occupation. Wool, sheepskins and tallow are exported. Port Stanley in E. Falkland is the chief town and trading centre and the seat of government. Pop. (1911) 2000. The islands discovered in the late 16th cent. were settled by France and Spain and finally ceded to Great Britain (1771).

Falkland Islands, Battle of (Dec. 8, 1914), a naval battle of the World

War between English and German squadrons. After the battle of Coronel in which von Spee destroyed Cradock's squadron, the battle cruisers *Invincible* and *Inflexible* under Vice Admiral Sturdee were sent to the S. Seas. Von Spee's squadron was lured to the Falkland Islands by a bogus cable sent from Berlin by a British secret service agent and arrived there soon after Sturdee. The Germans were surprised and chased. The German armoured cruisers *Scharnhorst* and *Gneisenau* and the light cruisers *Leipzig* and *Admiral* were sunk and only the light cruiser *Dresden* escaped. This act on broke the back of the German naval attack upon the trade routes other than that conducted by submarine warfare.

Fallacy see Logic

Fallières, Clément Armand (1841-1931), French President. Elected deputy in 1876, he held in turn the portfolios of the Interior, Education and Justice. He was Premier in 1883, President of the Senate eight times and President of the Republic 1906-13.

Fallopian (or Fallopio) Gabriello (1523-1566), Italian experimental anatomist, was born at Modena. His name is remembered chiefly in connection with his discovery of the ovarian tubes in the human female. He also named the vagina and placenta and investigated muscles in the head.

Fallow land left unsown for a period usually a year. Fallowing is a very ancient process. It was found that a crop deteriorated after it had been grown for several years on the same ground, partly because the roots had exhausted the soil and partly through the incidence of disease. Also a crop frequently produces chemicals from its roots which are injurious to itself if in too great quantity. The introduction of crop rotation, the application of the results of scientific investigation into the question of soil bacteria and artificial chemical manures and the better understanding of the life histories of insect and fungus pests have largely

replaced the method of fallowing with more productive methods of land cleaning

Green fallowing is the growing of some green crop, such as pea, bean, vetch, or mustard, to plough into the ground and increase the organic content of the soil

Fallow-deer, a medium-sized species of deer, c 3 ft high, distinguished by the end of the antler being palmated, i.e. expanded and flattened. It is found wild in Asia Minor, but was introduced into Great Britain in the early part of the 15th cent. Two varieties are found in English parks, one being fawn with white spots, the other dark brown

Fall River, American port in Massachusetts, S of Boston, an important centre for cotton manufacture. Other industries include oil-refining, silk, and hat-making. Coal and crude oil are the chief imports. The small Fall, or Quequechan, R which flows through the town, supplies it with electric power. The port enjoys considerable passenger and industrial traffic. Pop (1930) 115,250

Falmouth, English port on the S coast, between Truro and the Lizard, Cornwall. It is a popular holiday resort, the surroundings being of considerable natural beauty. The harbour accommodates large vessels, the docks are modern. Industries include fishing, shipbuilding, engineering, and brewing. Buildings of interest are the Church of King Charles the Martyr, Arwenack House, and the observatory. Falmouth is the headquarters of the Royal Cornwall Yacht Club. Pop (1931) 13,492

False Imprisonment, the unlawful detention of a person against his will. The remedies are a writ of habeas corpus, a criminal prosecution, or an action for damages

False Pretences, obtaining property by a crime akin to larceny (*qv*). The distinction is that in larceny the goods are taken against the will of the owner, whereas in false pretences he is induced by fraud to part with the

property in the goods. The penalty is penal servitude not exceeding 5 years. A prisoner charged with obtaining by false pretences may be convicted, though larceny is proved, and if charged with larceny may be convicted of obtaining by false pretences if that crime is proved

Falstaff, Sir John, soldier in Shakespeare's *Henry IV* and *Merry Wives*, a masterpiece of characterisation. See also **PASTOR**

Famagusta, historic town on the E coast of Cyprus, settled by the inhabitants of Salamis who were driven out by the Arabs in the 7th cent. It has existed since the 3rd cent B.C., and has been occupied by Genoese and Turks. The buildings of interest are the great mosque (a former cathedral), the fortifications, and the remains of several palaces. Pop c 10,000

Famine, shortage of food leading to the starvation or semi-starvation of the people of a region or country. Famine may be due to the failure of crops owing to weather conditions, etc., or, in modern times, to the stoppage of food imports by blockade or other artificial causes. In primitive societies famine is frequent, since there is no secondary source of supply to fall back on when the local crops fail. Rapid and efficient transport has greatly alleviated this, since no crop failure is so widespread that the deficiency cannot be supplied from some other part of the world, provided those who suffer have the necessary purchasing power. Famine caused by drought in tropical regions has also been diminished by large irrigation works, especially in India, where the failure of the monsoon formerly meant loss of life even to the extent of one-third of the total population. Famine due to crop failure is to-day common only in India, China, Russia, and other Eastern countries depending entirely on local produce. Charitable relief expeditions are usually organised where governmental relief is inefficient. In civilised countries famine is usually due to blockade (as in Central Europe in

1918-19) or to a collapse of trade and exchange (as in Russia in the same period). Even in modern times famine due to floods occurs in some countries while in others wheat is burned to keep down the supply in order to maintain the price.

Fan, a device automatic or otherwise used for creating a current of cool air in a heated atmosphere. A mechanical example is the electric fan in which metal blades are made to revolve rapidly. A large-scale development of the fan principle is the *Estero punkah* which moves to and fro when operated by a rope. The ancient Egyptians used large feather fans fixed to long poles. The folding fan of paper vellum or silk fixed to plats of wood bone or ivory which collapses into a compass easily held in the closed hand originated in Japan where it was an indispensable object of national and ceremonial significance while individually it could be used with skill and subtlety as an indication of its owner's moods and emotions. From Japan the fan came West. It appealed to the French artists of the 18th cent. as a charming framework for their decorative and elegant art. The painting of fans and the carving of the handles and plats has resulted in some very beautiful examples of both Western and Eastern art. See **CONNER CHARLES**.

Fandango, Spanish dance Moorish in origin and a mixture of the *bolero* and *seguidilla*. It is danced by couples to quick lively music played in triple time and accompanied by castanets to reinforce the powerful rhythm and also by the guitar and sometimes the tambourine.

Fanshawe, Sir Richard (1608-1666) diplomatist and translator produced versions of Italian and Spanish poets and of Camoens' *Lisad*. Little of his own work has survived.

Fantan, a Chinese gambling game in which bets are made on any corner of an oblong card with numbered corners. When bets have been made the banker places on the table a

heap of counters small coins or similar articles and divides them into fours. The winning number is decided by the number of counters in the last batch if one counter is left over No 1 wins if 2 No 2 and so on.

As a *card-game* fantan may be played by any number of persons with a full pack of 52 cards which are dealt out singly. Each player contributes an agreed sum or *ante* to the pool. The player on the dealer's left leads any card he pleases and the next player must play the next card above it, or pay another ante. The sequence is continued to the end of the suit the ace either beginning the sequence or being placed on the king. The player who completes the sequence starts another with any card. The first player to get rid of all his cards takes the pool. In another variation each sequence must be begun with the ace.

Fantana (mus.) a more or less impromptu composition bound by no formal rules. Also a selection of airs from the works of a particular composer or a particular opera.

Fanlin Latour Ignace Henri Jean Théodore (1836-1904) French painter and lithographer born at Grenoble. In Paris he exhibited at the Salon in 1861 but afterwards his work was shown with that of Manet Whistler Legros and others at the Salon des Refusés. His still life paintings are widely known and admired. His *Hommage à Delacroix* is a portrait group which includes Whistler Legros and Baudelaire and portraits of the Impressionist painters of Zola Verlaine and Rimbaud appear in later works of similar character. He produced a number of lithographs some now in the British Museum but it is in his portraiture that his work is seen at its best.

Farad, see **ELECTRICITY**.

Faraday Michael (1791-1867) English scientist was the son of a blacksmith and himself a bookbinder's apprentice. By attending his lectures

he gained the notice of Sir Humphry Davy, who made him his assistant in the Royal Institution laboratory (1813). He became Director of the laboratory in 1825 and Fullerman Professor of Chemistry (1833) in the Institution, where he remained for 54 years. His chemical discoveries in chlorine, the diffusion and liquefaction of gases, alloys, and glass, were eclipsed by his epoch-making electrical discoveries. In electro-magnetism, basing his experiments on those of Oersted and Ampère, he explained the continual rotation of a magnet and the electrified wire round each other. But his greatest discovery was that of electrical induction (1831). His third great discovery was of the magnetic rotation of the plane of polarised light. Apart from his scientific greatness, Faraday was respected for his humble and straightforward character and for his earnest religious impulses. (*See Life and Letters of Faraday*, Bence Jones, 1870.)

Faraday Effect, *see* MAGNETO-OPTICS

Farce, originally a canticle in a mixture of Latin and French sung in church at certain festivals, particularly Christmas. The term gradually came to be applied to a species of drama, and in its modern sense means a variety of comedy differing from other species in the grotesqueness and exaggeration of its character and action.

Farcy, *see* GLANDIERS

Far East, The recent disturbing events in China and Manchuria have their roots in the past. The problems involved in the conflict between a disintegrated empire alive with nationalist sentiment and the Imperialist powers of East and West were conditioned by a series of events that took place mainly in the last fifty years. The absorption of China and Japan into the economic life of the world brought the Powers Great Britain, France, and the U.S.A. into the Far East. Russia's landward expansion over Siberia brought her into contact with Eastern problems.

Finally there emerged a new great Power, Japan, with interests confined to the Pacific. These many problems interest all countries with spheres of influence or territory in the Pacific, and through them the whole world. They are economic, as is seen in the necessity for Japan either to find an outlet for her population, or a means, by way of foreign trade, to feed them cheaply and easily by imports, as did 19th-cent England. They are political also, as the Sino-Japanese conflict involves all the nations with important interests in China.

In the early part of the 19th cent., Japan was closed to foreign trade. In the Chinese Empire, foreigners were allowed to trade at Canton, but subjected to many restrictions and difficulties. The action of the Chinese in the prevention of opium smuggling led to the first and second Opium Wars 1839-41 and 1857-8. China could put up no effective resistance to Western powers, who forced her to trade at the bayonet's point. Treaty ports, where unrestricted trade was allowed, were opened. Foreigners were granted civil and criminal jurisdiction over their settlements, a system called extraterritoriality. By 1860, China had been opened up to foreign trade and the legalised opium trade increased the revenues of India and weakened the moral of China.

In 1854 Japan was opened to trade by an American battle squadron, and subjected to the same system of extraterritoriality. But, being more compact and better organised politically than China, Japan altered her political system so as to meet the West on equal terms. Her army was modernised and trained by European officers; representative forms of government were introduced, and the legal system reformed. As a consequence she demanded and obtained from Great Britain in 1894 and other Great Powers in 1895, the abolition of extraterritoriality, and other mark of inferior status.

Meanwhile the process of economic penetration in China had taken a new form and some outlying parts of the Chinese Empire were annexed by the Powers. The murder of a number of missionaries provided a pretext for war and war led to annexation. Great Britain obtained Burma, France Annam. That was the beginning of the breaking up of China. With the advent of Japan as a Power with the expansion of Russia and the completion of German and Italian unity the scramble for China began. Russia checked in her attempt to obtain a convenient outlet in the Mediterranean, expanded E to the Pacific principally with the object of obtaining a warm water port there. There were then four Powers closely interested in E affairs—Japan, France, Great Britain and Russia, with Italy and Germany trying to maintain their prestige by obtaining influence.

The first sign of Japanese import-
ance was the quarrel with China over the misgovernment of Korea. This led to war in 1895 and China, as easily defeated. By the Treaty of Shimonoseki Japan obtained the Liao-Tung peninsula, the Island of Formosa and an indemnity. The Powers, Russia, France and Germany refused to allow Japan to hold the Liao Tung peninsula, alleging that any foreign occupation of Port Arthur threatened locking Japan in. In 1897 another provocative murder, this time of German and French missionaries gave Germany the opportunity of obtaining a lease of Kiao Chow. Her rival, Russia, obtained Port Arthur, England Weihaiwei and France some territory near Tonkin, but Italy did not succeed in getting the bay for which she asked. It seemed as though the dismemberment of China was imminent. In 1900 these concessions led to anti foreign outbreaks in China known as the Boxer rising, called after a society of that name. They were suppressed by the combined armies of the Great

Powers who sacked Peking and destroyed and looted many of its most beautiful treasures.

The seizure by Russia of the coveted Port Arthur (1898) aroused Japanese opposition. Since Russia was bound by treaty to evacuate Manchuria and refused to do so, Japan declared war. The Russo-Japanese War of 1905 ended in victory for Japan. By the Treaty of Portsmouth, Japanese claims to Korea were recognised. Manchuria was evacuated by the Russians and Japan obtained the Liao Tung peninsula and half the Island of Sakhalin. An Eastern had defeated a Western Power and in this China saw the possibility of freeing herself from foreign domination by Westernisation.

The complete break up of China was prevented by the open door policy supported mainly by Great Britain and the U.S.A., whereby access to trade was to be available to all nations and the U.S.A. interested in the Far East by reason of her acquisition of the Philippine Islands (1898) showed plainly that she would not countenance a policy of partition.

Thus territorial division gave way to the policy of carving out spheres of economic influence, obtaining commercial concessions, railway leases, mining rights, etc. The economic problem of Japan was brought to the fore by the restriction imposed on Japanese immigration by the U.S.A. and Australia. In China itself the revolution of 1911 destroyed the empire and set up a republic in its place. On the outbreak of the World War the Far East had been opened to the economic exploitation of the West. The rise of an Eastern Power had shown China the possibilities that lay in adopting Western methods and China had taken the first step along this path by altering her form of government. Henceforth the main points in the Far Eastern question are the struggle of China to free herself from foreign control and set her own house in order and the policy of Japan

in seeking an outlet for her goods and sources of raw material

During the World War the Western Powers were occupied with more pressing matters than the Far East, and China was left at the mercy of Japan. By the 21 demands presented to China in 1915, Japan attempted to obtain very wide rights in China, which were granted under compulsion.

With the peace, the problem came once again to the front of international politics. By the Nine-Power Pact, 1921, the territorial integrity of China was guaranteed. With the victory of the S. Republican Party in the Chinese civil war, attempts were made to abolish the system of extra-territoriality and foreign control over Chinese administration. With the exception of Japan the Powers followed the policy of preserving the open door for trade, and of gradually agreeing to Chinese autonomy, as improvements in her administration justified it. Sino-Japanese relations were not improved. Japan claimed the rights she had obtained in 1915 by threat of force. China insisted on retaining full sovereignty and pleaded that the concessions were exacted from her under duress. Finally, Japan chose an appropriate moment, when domestic and economic troubles occupied the attention of the other Powers to occupy Manchuria and attack China proper, at first at Shinghai, and then from the N. (see MANCHURIA). China appealed to the League of Nations, but in the meantime Japan consolidated her position in Manchuria by converting it into the quasi-independent State of Manchukuo.

Far Eastern Area. Russian administrative district of Siberia extending from the E. coast inland to Yakutsk and the Buriat-Mongol Republic bounded N. by the Arctic Sea, and S. by Manchuria and Korea. Much of the surface is mountainous, great areas in the S. consist of frozen tundra. A large part is forested. Agriculture is carried on in the river

valleys, particularly in that of the Amur. Crops include rice, cereals (mainly wheat), flax, fruit, hemp, and soya beans. Attempts are being made to stimulate the production of sugar-beet and tobacco. The coastal fisheries are large and valuable. Timber and fur trapping are important sources of revenue. The region is rich in mineral wealth, but lack of ports hampers its exploitation, even though internal transport is fairly good. Various European firms hold concessions, and work gold, iron, lead, zinc, and other metals. There are no important manufactures, though the growing production of naphtha and coal may stimulate them. The inhabitants include several comparatively primitive races, the Paleo-Siberians, Neo-Siberians, Chukchee, and Kamchadals. Russian settlement is increasing, and accounts for most of the imports of foodstuffs, chemicals, and machinery. The chief towns are Vladivostok, Chita, Khabarovsk, and Okhotsk.

The region has been explored and settled during the last 400 years. The value of the furs first attracted traders and led to the building of forts on the coast, after the Russo-Japanese War (1905) the Russians retired from Korea and Manchuria, and settled within the present boundaries. Special encouragement to settle in this territory is given by the Soviet authorities and a part has been set aside for Jewish occupation, and the development of a Jewish Soviet republic. Immigration is going steadily forward. Area c. 1,000,000 sq. m., pop. (1931) 1,000,000.

Farinato, Paolo (c. 1522-1606), Veronese artist who made many paintings, especially some frescoes in the choir of SS. Nazario e Celso. Farinato's *Descent of St. Catherine* is now in the Veronese Museum; his best painting, a large and crowded *Missa of the Lovers and Fishes*, is in the Church of San Giorgio. He also executed a number of engravings and drawings, and some architectural work.

Farinelli (1705-1782), Italian vocal

me of the Italian singer Carlo
roschi. He was born at Naples
id was a pupil of Porpora making his
st appearance at Rome (1722) in the
era *Eumene*. Later he came under
e influence of Bernacchi. He paid
veral visits to Vienna and was a
avourite of the Emperor Charles VI.
1734 he came to England and then
roceeded to Spain where he remained
5 years acquiring great influence
ith both Philip V and his son Ferdi
and VI and persuading the latter to
stablish an Italian opera. He was
iven a pension of £ 000 a year and
timately retired to Bologna. His
oice was soprano and remarkable for
s compass of notes and perfect control.

Farm, a piece of land enclosed for
cultivation. Farms should be chosen
or their suitability for the kind of
arming their size the shape and size
f fields and their nearness to the
homestead the contours of the land
ffect the ease of cultivation and limit
roduction while also affecting erosion
and the consequent loss of fertility.
The physical properties of the soil
etermine the kinds of crops possible
and the fertility and easy working of
he soil. Drainage is extremely im
ortant. The climate requires con
sideration as it affects the number of
working days and the necessary shel
ers etc for cattle. The location is of
first importance for distance from
markets railways and roads the local
labour supply and the competition of
neighbours for labour and for the local
markets should all be taken into
account.

According to Professor Wrightson
67 per cent of farming capital is in
vested in live stock and 14 per cent in
implements and harness while the
remainder covers manual labour rent
manure and seeds. By a system
drawn up in the United States 1
horse = colts = 1 cow = 1 bull = 1
heifer 12 calf = 2 young cattle = 4
calves = 5 pigs = 10 young pigs = 7
sheep = 14 lambs = 100 hens = 1
un a cage a farm should

45 acres. This system

has been found very convenient for
purposes of comparison between farms.
The annual deterioration of farm
stock implements machinery etc is
some 10 per cent i.e. the whole of the
contents live and dead of a farm
require replacement every 10 years
and this has to be made good out of
profits.

In 1933 there were 6300 000 acres
of land in England under wheat bar
ley and oats and 398 000 acres
under root crops turnips swedes
mangolds and sugar beet while 4
million acres were under clover and
rotational crops. The total number
of cattle was 11 983 000 of sheep
9 045 000 and of pigs 4 407 000.

Farman, Henry (b 1874) French air
man born at Cambrai who after being
successively bicycle racer painter and
racing motorist took up aeronautics
and succeeded on flying almost $\frac{1}{2}$ m in
1907 and 16 m across-country in the
following year. He founded the Far
man Works at Boulogne sur Seine
which supplied military aeroplanes in
large numbers in the World War. In
1919 he built a giant air liner which
opened the Marseilles Morocco route.
Since the War he has held height and
duration records. In most of his
activities especially his initial biplane
experiments he was associated with his
brother Maurice.

Farmer John (1836-1901) composer
organist at Harrow and Balliol Coll. ge
Oxford. Wrote church and chamber
music and songs including the Harrow
school song *Forty Years On*.

Farmers General (*Farmers Gener
aux*) in France officers who farmed
the revenues. They were frequently
very oppressive and were abolished
by the Revolution in 1793.

Farnborough, Hampshire town not
far from Aldershot an important air
force and military Station. Parts of
the parish church date back to the 11th
cent. A French Benedictine abbey
was founded by the ex-empress
Fugène to receive the remains of
Napoleon III their son and herself.
Pop (1931) 16 350.

Farne Islands, several rocky islets off the Northumberland coast. A 12th-cent chapel on Farne is believed to stand on the site of the hermitage of St Cuthbert, who died here in 687. On Longstone, one of the islets, stands the lighthouse from which Grace Darling (*q.v.*) went to the rescue of the survivors of the wrecked *Forfarshire*. The islands are practically uninhabited and abound in sea birds.

Farnese [FAHRNÄ'ZÄ], Italian family, dating from the 11th cent., which governed Parma 1545-1731. Alessandro Farnese, who became Pope Paul III in 1534, conferred Parma and Piacenza on his natural son, Piero Luigi. Another Alessandro Farnese (1545-1592) was a general in France and the Netherlands, where he succeeded Don John of Austria as Governor-General, 1578. Elizabeth Farnese (1692-1766) married Philip V of Spain, and directed his whole policy. Their son, Carlos, acquired Parma when the male line became extinct in 1731. The Farnese Palace in Rome, built c. 1495-1526, is now occupied by the French embassy and the École de Rome.

Farnham, a popular residential centre, and market town, in Surrey, S. of Aldershot. Of interest are Farnham Castle and Moor Park, where Swift worked as Sir William Temple's secretary. Cobbett was a native of the town. Pop (1931) 18,294.

Farnol, John Jeffery (b. 1878), English novelist. After studying engineering and art successively, he began writing fiction, supplementing his earnings by scene painting for a New York theatre. He returned to England in 1910. His writings include *The Amateur Gentleman*, *The Broad Highway*, *Black Bartlemy's Treasure* (1921), *The Quest of Youth* (1927), and *Voices from the Dust* (1932).

Faro (*Pharaoh*), an old gambling card game, probably of Italian origin. A full pack of 52 cards is shuffled and placed in a *dealing box* with an open top and a slit in the side through which

the cards are drawn in couples. The top card in each deal is called *Soda*, and the bottom card *in hoc*, and neither counts in the deal. Each pair of cards drawn out forms a *turn*, and there are thus 25 turns to a deal. The first card withdrawn in each turn is called a *winner*, the second a *loser*, winners and losers being placed in separate piles. The object of the players is to guess which cards will be winners and which losers. Bets are placed on the *layout*, a complete suit of spaces enamelled on green cloth. Bets may be made so as to cover various combinations of cards, and cards may be backed either to win or lose. A *case-keeper* shows how many of each card have been withdrawn, and how many are left in the dealing-box. Each player may also keep a record on a score-sheet of the winning and losing cards on each turn. Faro has fallen into disrepute owing to its opportunities for dishonest dealing.

Faroe Islands, see FAEROE ISLANDS.

Farquhar, George (1677-1707), dramatist, wrote many plays for Robert Wilks, a popular comic actor. His best comedy, *The Beaux Stratagem* (1707), was revived at the Lyric Theatre, Hammersmith, in 1927. With Farquhar Restoration comedy came to an end, his works are more romantic and palatable than those of his immediate predecessors.

Farquharson, Joseph (b. 1846), Scottish landscape painter, became an A.R.A. in 1900 and an R.A. in 1913. He is well known for his paintings of Highland scenery, cattle, and sheep. His *Joyless Wintery Day* is in the Tate Gallery, London.

Farrant, Richard (1520-1580), composer, and organist of St. George's Chapel, Windsor. Wrote mainly Church music.

Farrar, Frederic William (1831-1903), English clergyman and author of *Eric, or, Little by Little*. He was a master at Harrow, 1855-60, and was appointed Head Master of Marlborough in 1871 and Canon of Westminster in 1876. He wrote school stories, *The Early Days of Christianity* (1882),

and many works on theology included a *Life of Christ* (1845).

Farren, William (1786-1861) English actor; his most famous part was Sir Peter Teazle. His sons **HENRY** (1806-1860) and **WILLIAM FARREN** (1805-1904) were also well known actors and his granddaughter **ELEANOR (NELLIE) FARREN** (1845-1904) daughter of Henry was famous for her male impersonations in the old Gaiety Burlesques.

Farriery the art of shoeing horses extended to veterinary science as applied to horses. Shoeing is carried out in this country by blacksmiths the ailments of horses being seen to by qualified veterinary surgeons. In the Army the farrier sergeant is responsible for shoeing the horses in his unit but has also some veterinary instruction.

Horse-shoes were formerly made by hand. To-day machine made shoes are supplied which can be modified by the smith to fit. Shoes are fastened to the hoof by means of nails driven into the dead part of the horn. The shoe should be affixed in such a way that the frog (a callous portion of the middle of the foot) shall touch the ground and act as a buffer to protect the horse's foot from shock. As the horn of a horse's foot is all rays growing shoes should be removed the horn pared down and the shoes if they are not too much worn replaced.

Fars, Persian province on the shores of the Persian Gulf extending some distance inland. Several of the more important coast towns including Bushire and Bandar Abbas are under separate administration. The province is hilly and the highest mountain Kuh Dā is 14 000 ft. Agriculture is the chief occupation and cereals, cotton and tobacco are produced. Unsuccessful efforts have been made to discover petroleum. The chief town is Shiraz. Fars was the original Persian home of the conquering Persian race. Area c 60 000 sq m. pop c 740 000.

Farthing (A.S. *feorika* + *ing* = fourth

part) the smallest current English coin with a value of one quarter of a penny. It was a silver coin from the reign of Edward I to that of Mary II, no issue being made by Elizabeth I. The copper farthing was introduced by James I in 1613. This was however really a token the true copper farthing coin being first issued by Charles II who also had a tin one struck with a copper centre. Bronze was substituted in 1860 and half farthings were coined between 1841 and 1869.

Farthingale, hoop made of whalebone or wood used in its most extreme form in the 17th cent as a support for widespread skirts. It originated in Spain and was the precursor of the crinoline.

Fasces, bundles of wooden rods made of elm or birch strapped together with an axe whose head protruded at right angles from the sticks. The fasces symbolised the authority of the senior magistrates of ancient Rome and were carried by the lictors who preceded them. With the foundation of the republic the fasces were borne in front of a consul and later the axe was removed within the city in recognition of the fact that consuls had been deprived of their extreme powers over the lives of the people. The number of fasces allotted to the different officials varied according to their station, e.g. consuls were preceded by twelve fasces but a dictator was permitted double that number complete with axe. Italian fascists derive their title from these ancient fasces.

Fasciation [*FASIA* SHUV] the production of a large number of branches usually abnormally. A fungus disease introduced recently into England has caused fasciation in willow trees which bear thick tangled masses of twigs resembling birds' nests composed of numerous tiny twigs. Fasciation of garden plants is seen especially in Composite flowers (i.e. dahlia, chrysanthemum, coreopsis) and in primulas.

Fascism, a political movement originating in Italy which holds that

the individual exists for the State, to whose good all his work and interests should be directed. Its origin is to be found in a *Fascio di Combattimento* founded at Milan in March 1919 by the ex-Socialist Benito Mussolini, then Editor of the *Popolo d'Italia*. This body consisted of 150 personal friends, mostly ex-soldiers and ex-Socialists, and its feeling was strongly nationalist, with some flavour of syndicalism. It was antagonistic to the Italian Liberal Government of the day, which, it was believed, had betrayed the country's interests at the Peace Conference, it also opposed the growing Socialist and Communist movement. In the latter part of 1920 the Fascist movement, now penetrating the whole country, gained considerable power in the municipalities, where it joined with other parties to defeat the Socialists. Armed bands or *squadre* were formed, and their ranks swelled by D'Annunzio's followers after the evacuation of Fiume, the uniform of the movement being black shirts with the Roman emblem of the Fasces (*q v*), representing unity. Thirty-eight Fascists were returned at the elections of May 1921, and in Nov a fully-fledged political party was established. In the crisis of Oct 1922 Mussolini ordered a concentration of Fascist bands on Rome. The King refused a request by the Government to declare martial law, accepted the Government's resignation, and telephoned to Mussolini in Milan, inviting him to form a Government. Mussolini and his Fascists then "marched" into Rome unopposed. Since that time, at first with the co-operation of other parties, afterwards alone, Fascism has remained the ruling power in Italy, with Mussolini as leader of the party and head of the Government.

Fascism regards the preservation and glorification of the State as its highest ideal. Parliament may only regulate the individual as citizen and promote national interests, especially in maintaining prestige in foreign affairs. Industrial production is pre-

sided over by trades councils, and all individual action which might be prejudicial to the State, such as strikes and lock-outs, is forbidden. Trade unions are encouraged so long as their influence is constructive, but all disputes between employers and employed are subject to compulsory arbitration. Propaganda directed against the Fascist régime is not permitted, nor is any political opposition. At first republican, the Fascist movement came gradually to support the monarchy, and also made friendly terms with the Vatican in the Lateran Treaty of 1929.

The National Socialist movement in Germany, led by Adolf Hitler, adopted many of the principles of Italian Fascism.

Fashoda (*Kodok*), town on the White Nile, 459 m S of Khartoum. Cotton is produced in the district. The name became universally known in connection with the "Fashoda Incident" (1898), when the town was occupied by Major Marchand, a French officer, who had come across from the French W African territory. The matter was referred to London and Paris, and the French force was eventually withdrawn. France subsequently renounced her claim to the Nile valley.

Fasting, partial or complete abstinence from food or from certain kinds of food, mainly for religious reasons. It has been recognised from the earliest days of Christianity as a pious exercise, and is also a Jewish and Mohammedan religious practice. The great Christian fast, observed by the Catholic and Eastern Churches for 40 days before Easter, is *Lent*; other shorter fasts are also kept. In Protestant circles fasting is a matter of private rather than communal devotion. Mohammedans observe an annual fast during the whole month of Ramadan, the principal Jewish fast is Yom Kippur, or the Day of Atonement (*q v*). In the Catholic Church a distinction is made between fasting, which regulates the amount, and abstinence, which is concerned

with the *nature* of permissible food

Fastolf, Sir John (d 1409) English soldier. His reputation as a braggart and his connection with Lollardry. Thomas Mowbray and the Boar's Head Inn Southwark originated the idea that Shakespeare based his creation of Sir John Falstaff (*Henry IV*) on his character. Fastolf served with Henry V in France, became Governor of Maine and Anjou and after over coming the French at Orleans 1429 was himself defeated at later.

Fatal Accidents Act, 1916 (*Lord Campbell's Act*) altered the common law principle that it is not a wrong actionable at the instance of his relatives to cause the death of a human being. It provided that the spouse, children, grandchildren, stepchildren, parents, step parents, and grand parents of a person killed through the fault of another may recover damages if the deceased had been merely injured and not killed, would have had a right of action, and if such relatives have suffered pecuniary loss in consequence of the death. This last proviso is satisfied by proof of a reasonable expectation of pecuniary benefit from the deceased had he remained alive. See also **TORT**.

Fatalism, the doctrine that all the events of human life are predestined and that it is futile to struggle against destiny. This was the view of Epicurus and the Stoics who maintained that this destiny was beyond the power even of God to alter. Later it came to have a theological basis in the belief that life is controlled by laws promulgated by a supernatural being and also by natural laws and is apparent in the doctrines of Spinoza. It is dominant in Eastern thought especially among the Mohammedans who regard fate (*kismet*) as an absolute power to which they submit with perfect resignation.

Fatehpur Sikri, Indian village in the United Provinces famous as the entire creation of Akbar and for the ruins of a mosque built by him, one of the finest in the country. A striking

are the gateway and the tomb of the Christian saint Shaikh Salim Akbar's palace in the vicinity is also of interest.

Fates, The, in classical mythology the three goddesses who presided over human destiny. They were called Parca by the Romans and Moiræ (among other names) by the Greeks. They were the daughters of Nox and Erebus and were named Clotho (who spun the thread of life), Lachesis (who turned the spindle and drew out the thread) and Atropos (who held the scissors and cut the thread).

Fat Hardening. The hardening or hydrogenation of liquid fats to give a solid product is a recent development. The first experiments in this subject having been carried out some thirty years ago. The great advantage of hydrogenation is that by its means we are able to obtain from the relatively cheap and plentiful liquid oils products very similar in type to the more valuable and scarcer solid fats which are used in the manufacture of soap, candles and edible fats. Since chemically the difference between hard and liquid fats lies in the amount of hydrogen that they contain, numerous workers tried to develop methods whereby hydrogen could be artificially added to liquid fats so as to convert them into hard material. Success was finally achieved by the use of catalysts (*q.v.*) to accomplish the process.

The catalyst most widely employed in modern fat hardening is the metal nickel in a finely divided form. The nickel may either be placed directly in the fat or may be put on a carrier, which is usually some type of earth, and the catalyst-covered carrier placed in the fat. When the catalyst has been placed in position on a stream of hydrogen is passed through the liquid till it has been hydrogenated to the required amount. When the process is completed the catalyst is removed from the fat by filtration and the fat allowed to cool. See also **OILS**, **FATS** AND **WAXES**. **CATALYSIS**, **INDUSTRIAL APPLICATIONS**. **Fathers of the Church**, ecclesiastical

writers of the early Christian Church, who have left behind teachings which guide their successors. Their controversies were useful at the Reformation, when both sides, even the Protestants, who based their opinions on the Scriptures, did not hesitate to draw on the Fathers for arguments. Among them are Ignatius, Clement of Rome, Polycarp, Justin Martyr, Origen, etc.

Fathom, see WEIGHTS AND MEASURES

Fatimites (or *Fatimides*), an Arabian dynasty (c 910-1171), which claimed descent from Fatima, daughter of Mohammed, and the Caliph Ali Obeidullah UBAID-ALLAH who reigned c 909-34 conquered N Africa, and extended the empire to Sicily and Egypt. MOEZ HEDINALLAH (952) founded Cairo and mastered Sicily and Egypt 972. AL-AZIZ (succeeded 977) conquered Syria and Palestine, but these territories were lost by his successors, Jerusalem falling to the Crusaders in 1099. The dynasty ended with Al-Aziz, succeeded by Saladin, head of the Ayubites, as Caliph of Egypt in 1171.

Fats, in chemistry, those fatty oils which are solid at temperatures of 20°C and below. See also OILS, FATS, AND WAXES.

Fatsia japonica, plant (*Aralia Sieboldii*), with large ivy-shaped leaves, grown as an ornamental shrub, either as an indoor plant or in sheltered places out of doors. It thrives in sandy loam, and is propagated by cuttings.

Fatty Acids, see ACIDS, FATTY

Fatty Degeneration, a change in the cells of animal tissues in which the protein material is replaced by fat. Normally fat in the tissues is stored in special cells or oxidised to form body heat, but sometimes, usually owing to a toxic agent, the power of oxidation is interfered with. It is also brought about by arsenic or phosphorus poisoning, pernicious anaemia, or lessening of the blood supply to an organ by narrowing of the arteries, this last being a

common cause of fatty degeneration of the heart. Heart degeneration most commonly arises in old age, and in persons addicted to alcohol, or may be due to influenza, pneumonia, or an enlarged heart. It is characterised by pain in the left side of the chest, palpitation after exertion and fainting fits, and there is danger of sudden death. The deposit of fat on the heart in stout people is due to fatty infiltration and is less serious.

Fault (geol.), a dislocation in the earth's crust in which one part has moved relatively to the other. The movement may affect one or both sides of the crack, and may shift them either up or down. The breadth of a fault may vary from a crevice to many yards. Faults may be vertical, but are usually inclined, in which case the two sides will be shifted horizontally in respect to one another, as well as vertically.

The vertical displacement, called the "throw," may vary from a few



FIG 1

inches to thousands of feet, the horizontal displacement is the "heave," and the inclination of a fault from the vertical is its "hade." Big faults are usually nearly vertical, those with a displacement of only a few yards are often nearly horizontal and have a high hade. Fig 1 shows an inclined fault, A, and a vertical fault, B. The "throw" of the two faults is the same, but fault B has no "heave" and no "hade," while fault A has a high value for both.

There are two main classes of faults: **Normal Faults**, in which one side subsides, chiefly as a result of gravity, and **Reversed Faults**, in which, owing to stresses in the earth's crust, beds on one side of the fault are pushed up over beds on the opposite side (Fig. 2). Normal faults slope towards the side which has gone down, and never bring part of a bed below another part of the same bed, so that the same plane can

ever be met with twice in the same vertical shaft but reversed faults or

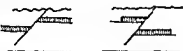
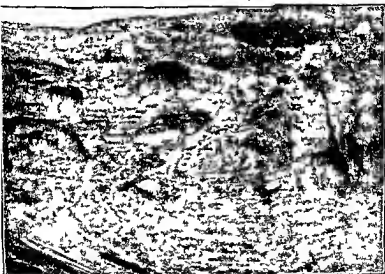


FIG 2

overthrusts slope in the direction of pthrow and the same bed may occur twice in a vertical shaft—hence the

pushed Devonian beds over the normally overlying carboniferous strata Fig 3 shows a section across the N W Highlands with beds numbered successively from oldest to youngest Thrust faults are marked F

Since strata are seldom horizontal over any great distance sooner or later most faults traverse inclined beds They may do this either in a direction more or less parallel to the dip of the rocks or parallel to the strike (q 1)



A Reversed Fault with Lower layers below younger beds

importance which faults have in mining Overthrusts are most frequent in mountainous regions where they may affect enormous areas of country as in the Alps and N W Highlands of Scotland In the latter district successive periods of thrusting are evident driving the older rocks across the younger and later denudation has in many cases left isolated patches of older rocks resting on younger beds The grande faille du Massif in N France and Belgium is a famous example of a thrust fault which has

that is at right angles to the dip They are designated accordingly dip-faults or strike faults Displacement of



FIG 3

beds a frequently the result of several faults in combination Sometimes however adjacent faults may tend to neutralise each other provided their

downtthrow is in opposite directions. Step-faulting (Fig 4) is often found



FIG 4

This is due to a series of small faults, with a downthrow in the same direction, the cumulative effect of which often gives rise to a considerable displacement of beds. Step-faults are well shown in the Scottish coalfield, and on a small scale there is a good example near Charmouth, on the Dorset coast.

When parallel faults shift beds in opposite directions, they may cause a piece of country between them to sink relatively to the ground on both sides in what is called a trough-fault. Fig 5

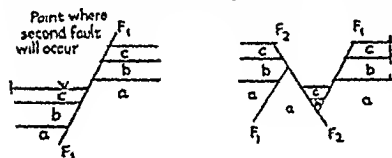


FIG 5

shows the formation by a trough fault of a Rift Valley (*qv*) or Graben. The fault connected with the great Rift Valley of E. Africa is probably the largest in the world, being some 1500 m in length. An area of country which is upstanding through subsidence due to surrounding faults is known as a fault-block or horst, of which the Vosges and Black Forest Mountains are well-known examples. Sometimes, when a series of beds are subjected to thrusting, the lower strata may move more rapidly than the upper and a "lag-fault" may form between one or more of the beds. These are obviously the converse of thrust faults. Minor faults, due to unequal "lag" in an individual bed, are called "tear faults." The Lake District shows both these types.

The upthrow side of a fault is always more liable to denudation than the

downtthrow side, but it may persist as a fault-scarp, resembling a cliff. The effect of the unequal denudation on the two sides of a fault is shown by curved strata, *i.e.* anticlines and synclines (*qv*). Since these are composed of beds thrown respectively into convex and concave curves, it is obvious that as the rock is planed away on the upthrow side the outcrop of the former will widen, while that of the latter will become narrower.

Faults are one cause of earthquakes (*qv*).

Fauna, a comprehensive term for the animals inhabiting any district, country, or continent. See **FAUNUS**.

Faunus, in classical legend, the god of the countryside. The grandson of Saturn, he gave his name to Fauns, country deities, horned, with pointed ears and goats' legs and hoofs, and to Fauna, his wife, a rustic goddess.

Faure[fōr], François Félix (1841-1899), President of the French republic, was Colonial Under-Secretary, Vice-President of the Chamber, Minister of Marine in 1894, and became President of the Republic in 1895. He cemented the Franco-Russian Alliance with Tsar Nicholas II, 1896-7.

Fauré, Gabriel (1845-1924), one of the most notable modern French composers. Born at Pamiers, he was a pupil of Saint-Saëns and subsequently organist at the Madeleine. Became Professor of Composition at the Conservatoire and later Director. Fauré wrote some beautiful sonatas for



Faun

olin and piano and cello and piano and some very fine songs. These and a chamber music generally contain his best work.

Faust [fəʊst] the legendary 16th-century magician almost certainly was an actual person though his identification with any known character cannot be established. The story of his bargain with the Devil for the restoration of his youth in exchange for his soul has been told in many ballads, stories and puppet plays, but Marlowe (qv) was the first to weld these into great dramatic form in his *Dr Faustus* (c. 1593). The legend is now chiefly known through Goethe's (qv) *Faust* and Gounod's (qv) opera *Faust*, see **PAINTING**.

Faversham, a town in Kent on a tributary of the Swale. It has a considerable local shipping traffic as well as lucrative oyster fisheries. There is also a considerable trade in fruit. Brewing and cement making are the chief industries. A tomb in St Mary's Church is believed to be that of King Stephen. From an early date Faversham shared the Cinque Ports privileges. Pop. (1931) 10,001.

Favre [fəvʁ] Jules Claude Gabriel (1809-1880) French politician fought in the revolutions of 1830 and 1848 and with Victor Hugo forcibly opposed Louis Napoleon's ascendancy. He became leader of the Republicans in 1863 and after Napoleon III's defeat by the Prussians at Sedan in 1870 demanded he should be deposed. As Foreign Minister in the Republican Government Favre negotiated the peace of 1871 with Bismarck who forced him to cede Alsace-Lorraine. Favre was discredited and resigned.

Fawcett, Henry (1833-1884) English economist and politician. Loss of his sight led him to abandon law for political economy and after the publication of his *Manual of Political Economy* he was appointed to a chair at Cambridge. Radical M.P. in 1880.

stone he introduced the parcel post, postal orders, sixpenny telegrams, the Post Office Savings Bank and insurance facilities. He wrote *Indian Fables* and *Free Trade and Protection*.

Fawcett, Dame Millicent Garrett, O.B.E. (184-1919) English feminist leader. Soon after her marriage in 1867 to Henry Fawcett (qv) she joined the movement for women's suffrage. Her efforts over fifty years culminating in the Representation of the People Act 1918 by which 6 million women were given votes. She also worked for the higher education and employment of women. Dame Millicent was President of the National Union of Women's Suffrage Societies and wrote *Women's Suffrage: The Women's Victory* (1919) and *What I Remember* (1924).

Fawkes Guy (1570-1606) English conspirator. Born in Yorkshire a Protestant he became a Roman Catholic and agent of the Spanish party in England which planned to destroy James I as revenge for his persecution of their co-religionists. Fawkes assisted Catesby and others in the Gunpowder Plot to blow up Parliament House but was arrested in a cellar under the building on Nov. 5, 1605 and hanged. England celebrates the day with popular fireworks displays.

Fayolle [fəvɔl] Marie Emile (185-1931) French soldier. He became general in 1910 and during the World War served under General Pétain at Vimy and the Somme succeeding to his command in 1917. He commanded for a time in Italy, returning to check the German offensives of 1918. Fayolle was made marshal of France 1921.

Fayum (fəˈjuːm) Egyptian province centring round an oasis W of the Nile c. 80 m from Cairo. It is fertilised by Nile mud brought down the Bahr Yusuf Canal. It has greatly benefited from the Aswan Dam.

figs and large crops of cotton, cereals, and grapes. The chief town is Medinet-el-Fayum (pop 52,850), an important agricultural town which stands near the site of the ancient Arsinoe, where the sacred crocodile was worshipped. Other towns are Tomia and Senaru. There are a number of interesting ruins around the shores of Lake Birket-Qarum Area, 675 sq m, pop 555,000.

Feather Grass (*Stipa*), a perennial ornamental grass c 2 ft high which flowers in summer, and thrives in ordinary soil. It is grown from seed sown out of doors in late spring.

Feathers, the external dermal covering of birds (*qv*). Since birds are descended from extinct reptiles, there must have been a time when scales were changed into feathers, but although scales and feathers resemble one another in the early stages of growth, there is no resemblance between them in the completed state, and the steps by which scales were turned into feathers are quite unknown. A typical feather is an elaborate structure. It consists of a hollow basal part, the quill, which passes into the shaft, where the vane or web begins, and at that point there is frequently a small accessory fluffy branch called the after shaft. The vane or web on each side of the main shaft is made up of a compact series of fine barbs, themselves provided with hooks, and the latter with hooklets by means of which the barbs are tightly locked together.

The surface feathers of the body are typically constructed in this way, those covering the body being small and those on the wings and tail, known as the flight feathers, large. But in some of the flightless birds, like the emu (*qv*), the barbs of the covering feathers are not united, and the whole plumage is soft and fluffy. These feathers in many respects resemble the down feathers, which lie close to the skin, and are of various kinds, but the latter are soft and fluffy, and more numerous than the covering

feathers, which usually conceal them entirely.

Feather Star, the free-living adult stage of some existing species of scaphites, also known as stone lilies or Crinoids, belonging to the phylum Echinodermata (*qv*). It consists of a central disc, beset with filaments on the lower side, and of 10 long, many-jointed flexible arms with 2 rows of pinnules like the vane of a feather. In its early life the feather star is attached to the sea bottom by a jointed stalk, but from this it breaks away while still young, and swims freely by raising and lowering its arms, or crawls about the rocks and weeds, pulling and pushing itself along by means of its sharp-pointed pinnules.

Featherstitch, see **NEEDLEWORK**

Fécamp, France, port and holiday centre in Département Seine Inférieure. Of particular interest is the abbey church, originally a convent, containing the relic of Christ's blood which, according to legend, drifted in the trunk of a fig tree to the shore near by. The local fisheries are important. Benedictine liqueur made here is exported. Pop 17,165.

Federal Council of Evangelical Free Churches, a body with the object of co-ordinating the common activities of the English Free Churches consisting of representatives of the governing bodies of the constituent Churches.

Federal Reserve System, the central banking system of the United States of America, established by the Federal Reserve Act of 1912, with 12 Federal Reserve districts each having a Federal Reserve Bank and with a Central Federal Reserve Board.

Owing to the great distances, sectional and geographical differences in economic conditions, business customs, and banking requirements, the devising of a central banking system for the United States presented considerable difficulties. The difficulties did not make the need any less, however, and the devastating periodic banking panics which had been experienced finally

resulted in an effort to solve the problem.

The chief need was for centralisation of bank reserves. In 1914 there were 10,000 banks in the United States each dependent upon its own cash reserves alone in case of a run. This meant that nervousness led at once to a scramble by all banks to strengthen their reserves to the keeping of high cash reserves and to relative instability generally. There was also no machinery for making the quantity of money and credit sufficiently elastic to meet the peculiarly heavy seasonal fluctuations of the business of a great agricultural country. The fact that business communities were scattered over so large an area, on the other hand, made the natural growth of one financial centre with a central bank as in most European countries unlikely.

The Federal Reserve System was designed to retain the features of the banking system which had developed to meet the needs of geographical and business differences and at the same time to provide centralisation of reserves, elasticity of money and credit and greater facilities for clearances of cheques and other credit instruments.

The country is divided into 12 districts with a Federal Reserve Bank in each district. All national banks and banks organised under the federal laws of the United States must be members of the system and subscribe to the capital of the Federal Reserve Bank in their respective districts to an amount equal to at least 6 per cent of their capital. State banks and banks organised under the laws of any one of the 48 States of the Union may be members of the system provided they conform to certain standards.

In each district member banks are divided into big, middle-sized and small banks. Two directors of the Federal Reserve Bank are elected by each group, each bank having one vote. Three directors are appointed by the Reserve Board, one of whom is chairman. Of the three, one is appointed by the member

banks, three one from each group are bankers and three are business men or farmers. Thus the management of the Federal Reserve Banks is in the hands of nine directors representing equally banking business and public interests.

The Federal Reserve Board which co-ordinates the management of the 12 Federal Reserve Banks and directs the general monetary and credit policy of the system sits in Washington. It has eight members including the Secretary of the Treasury and the Comptroller of the Currency (who are *ex-officio* members) and six others appointed by the President with the advice and consent of the Senate. A Federal Advisory Council consisting of one member from each of the 12 Federal Reserve Banks meets at least 4 times a year with the Federal Reserve Board. The Board itself meets constantly and maintains a large office with statistical staff. It publishes the Federal Reserve Bulletin monthly containing extensive statistical data about the banking and business condition of the country. The Board directs the general policy of the system.

The Federal Reserve Act provided for the gradual taking over from member banks of their reserves by the Federal Reserve Banks thus furnishing the much needed centralisation. Mobility of reserves between the districts was also provided for. Elasticity of credit was provided by the rediscount facilities furnished by the Federal Reserve Banks to member banks and elasticity of currency by the issue of federal reserve notes which not being countable as legal reserves by member banks tend to be returned by them when deposited by the public to the Federal Reserve Banks where they can be retired. The system has also greatly improved the cheque clearing facilities between different towns and sections of the

In most respects as a Central Bank of a European State do (see C

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Government banks with the system exclusively, and the system manages the National Debt. The Federal Reserve Banks are the banks of the commercial banks, and exercise control of the money market by means of their re-discount rates and by *open market operations* (q.v.) They also hold the bulk of banking reserves of the country.

There remain a large number of banks outside the system, a fact which many believe contributes to the comparative weakness of the American banking system as a whole. Much has been done to encourage State banks to join the system but their number has diminished, though partly as a result of amalgamations and failures. The following table shows the number of banks in and outside the system at different dates, and the total capital of each group.

December 31	Number of Banks			Deposits (Millions of \$)		
	All Banks	Member Banks	Non-member Banks	All Banks	Member Banks	Non member Banks
1923	30,178	9,774	20,404	42,163	24,996	17,167
1929	24,630	8,522	16,508	55,289	33,865	21,423
1931	19,966	7,246	12,720	45,821	27,432	18,389
1932	18,390	6,816	11,574	41,643	24,803	16,840

Federal State, a perpetual union of several sovereign States, which has organs of its own and is invested with power over the member-States and their citizens. This direct power over the citizens of its member-States distinguishes a federate-State from a confederation (q.v.). Examples of federal States are the U.S.A., Switzerland, and Germany. See also **FEDERATION**.

Federalist Party, an American political party led by Alexander Hamilton and John Adams, which supported the Constitution of 1787, and remained in power from 1789 to 1801. It reorganised administration, and worked for the centralisation of power, as opposed to State autonomy. Most of its policy was adopted by the later Republican Party.

Federated Malay States, see **MALAY STATES**.

Federation, a union of States in which the participants retain autonomy in local matters, while a Central Government determines questions of common interest. Among famous historic federations may be mentioned the Thessalian, Æolian, and Achaean leagues in ancient Greece, and the mediæval Hansa Federation of German and Baltic cities. Rapid communication and international trade encouraged the formation of large national units in the 19th cent. The American States federated under a Central Government in 1777-87, the Swiss Cantons in 1848, and the German States in 1871. The system has also been used in the development of self-government in the British Empire, notably in the federation of the Canadian provinces, the Australian

States (1901), the S. African colonies (1909), and in a limited degree the Malay States (1909). Russia, under Bolshevik rule, has also become a federation of smaller States.

Federation of British Industries, an association of manufacturers and producers, founded in 1916 and incorporated by Royal Charter in 1924. It represents manufacturing interests, conducts research into taxation, factory legislation, smoke-abatement, river-pollution, and similar matters, and presents the corporate opinions of its members in official quarters. It also advises its members on technical points of marketing, export, insurance, publicity, economy developments, etc. Besides a staff of experts at headquarters, it maintains representatives in 100 centres at home and abroad.

Fehling's Solution, a laboratory reagent consisting of a solution containing copper sulphate caustic soda and a double tartrate of potassium and sodium (Rochelle salt). The solution is usually made up in two parts (A) containing 69.3 grammes of copper sulphate ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) in a litre and (B) containing 350 grammes of sodium potassium tartrate and 120 grammes of caustic soda in a litre. Fehling's solution is used in the laboratory as a method for the quantitative estimation of sugars: the sugar under examination is dissolved in water and the solution titrated (qv) against a known volume of the Fehling's solution prepared by mixing together equal amounts of solutions A and B. The end point is reached when the blue colour due to the copper sulphate disappears. From the titration figures it is possible to calculate the amount of sugars in the solution tested.

Fehmeio Courts, tribunals of free citizens which became established in 14th-cent. Germany, particularly Westphalia with the object of combating feudal tyranny. Their sittings were often secret: they could only pronounce sentence of death and derived their jurisdiction directly from the Emperor. Abuse ultimately led to their suppression. The term *Fehme* was applied to a series of political murders directed against Socialists and members suspected of treachery by secret organisations of the Right in post-war Germany.

Féis Ceoil, an annual musical festival which has been held at Dublin since 1897.

Faisal al Hossin [fī zōōLAHL hōōsīn] (1885-1933) King of Iraq. Son of King Hussein of Hejaz: he joined the Arab Nationalists in 1913. In 1915 he escaped from Syria to the Hejaz. As leader of the Arab forces he co-operated with General Allenby and T. E. Lawrence in the defeat of the Turks in Syria 1916-18. He was appointed King of Syria in 1920 but resigned when the territory became a French mandate and was elected King

of Iraq the following year. He visited England in 1919-20 1927 and 1933.

Felidre see CATS.

Felixstowe, popular seaside resort, yachting and tennis centre in Suffolk on the mouth of the R. Orwell: the promenade is more than 1 m. long. It is a seaplane base and a naval wireless station. Phosphate of lime is found in the neighbourhood and exported. There are interesting Roman remains near by. Pop. 12,037.

Fell, John (1655-1686) English bishop fought on the King's side during the Civil War and kept up the Church of England services throughout the period of the Commonwealth. Consecrated Bishop of Oxford in 1676: he did much to encourage learning at the University and promoted many buildings including the Sheldonian theatre. His stern discipline drew from one of the undergraduates Tom Browne the following *extempore* translation of a famous epigram of Martial:

I do not like thee Doctor Fell!
Thy reason why I tell!
But thus I know I know full well!
I do like thee Doctor Fell!

Fellah (pl. *Fellākin*) Arabic word used to signify the Egyptian peasant, probably a racial descendant of the ancient Egyptians. See also AFRICA, PEOPLES OF.

Fellow, a graduate member of a university elected to perform some specific governing or tutorial work for which he receives a fixed salary. The term is also applied to members of certain learned and other societies. The title of *honorary fellow* at a university is given in recognition of noteworthy work but carries neither duties nor emoluments.

Felo-de-se (*Lat.* a felon with regard to himself) one who commits suicide. Until 1832 it was the practice in England to bury suicides at a cross roads with a stake driven through the body but a statute of that year directed burial in a churchyard or burial ground without religious service between the hours of 9 p.m. and midnight. In 1832 both these restric-

tions were removed. A coroner's inquest must be held on every suspected suicide and, in the absence of evidence of unsoundness of mind, a verdict of *felo-de-se* must be returned. Attempted suicide is punishable with 2 years' imprisonment. For the so-called suicide-pact, see MURDER.

Felony, in English law a kind of crime distinguished from treason and misdemeanour. The distinction is now mainly of historical interest. A felony was originally an offence punishable by the forfeiture of the felon's property, but a great many other offences are by statute felonies, and forfeiture is now abolished. Nor is there any distinction in regard to the severity of the punishment. The only differences that remain are that there are greater powers of arrest in the case of felonies, that concealment of felony is a crime, that only in felonies is the distinction between a principal and an accessory recognised, and that conviction for felony entails loss of certain civil rights until the punishment has been suffered or a pardon granted. See also CRIMINAL LAW.

Felsite, a term loosely applied to fine-grained, acid, igneous rocks, both hypabyssal and volcanic (*qqv*). They are generally light-coloured, dull, and stony in appearance, and consist in the main of a mixture of quartz and felspar (*qv*), the varieties containing conspicuous crystals of quartz being called "quartz-felsites."

Felspars (or *Feldspars*), silicates of aluminium, together with varying amounts of silicates of potassium, sodium, calcium, and barium. They form the many common minerals, which compose nearly 60 per cent of the earth's crust; they are rather more common in igneous rocks than in sedimentary. They fall into two main divisions, with different crystal-line symmetry (see MINERALOGY). Orthoclase, and one or two rare minerals, crystallise in the monoclinic system, but most felspars are triclinic, and are termed "plagioclase" felspars.

Felspar is colourless in the pure state, but most impurities impart a white, red, green, or yellow colour, which may suffice to make it an ornamental stone. Orthoclase, and sometimes albite, may occur as moonstone and sunstone (aventurine), the former an opalescent, the latter a spangled, stone. Amazon stones are fine, large, green crystals of microcline. Labradorite, from the granites of Labrador, is well known for its beautiful iridescence, and so is often built into the interiors of buildings. The felspars are all slightly harder than an ordinary knife, and vary slightly in weight according to their composition. Their economic value is as a flux used in the ceramic industry, and they are used in the body of the ware, in the glaze, in the manufacture of glass, and for enamels, roofing material, polishes, scouring substances; also, when very pure, for artificial teeth. Enormous crystals are found in America, up to 20 ft in diameter, in pegmatite dykes (*qv*).

Felsted (or *Felstead*), a village $8\frac{1}{2}$ m N of Chelmsford, Essex. The church contains a monument to the 1st Baron Rich, founder of the public school here (reconstituted 1852). Pop c 2000.

Felt, a fabric which is not woven, but made of fibres, usually wool, which, when subjected to beating and vibration, grip one another in the form of layers.

Felucca, a fast Mediterranean sailing-vessel used chiefly for fishing. It is long and narrow, with a high bow and large lateen sails.

Feminism, a movement for bringing about absolute equality, both legal and social, between the sexes. Though only of 19th-cent origin, much has already been done to remove various disabilities formerly suffered by women. One of the earliest advocates of woman's rights was Mary Wollstonecraft Shelley. John Stuart Mill in his essay on "Liberty" put forward very advanced views for his day, on the question of married women's property and divorce. The

ssing of the Married Women's Property Act of 1882 giving married women control over their own property. The first big step was the Divorce Act of 1923 by which the tests were placed on an equality as regards the grounds for divorce and the Legitimacy Act of 1926 whereby children can be legitimised by a subsequent marriage of the parents are lists of feminist movements.

The Women's Suffrage campaign the years before the War under Mrs Pankhurst and her daughters moved with what determination women were fighting for their cause. The Divorce Law Reform Union, the Society for Constructive Birth Control and the National Council for Equal Citizenship are all engaged in different aspects of the feminist movement. Law Ibsen Brieux and others have written provocative feminist plays.

Scandinavian countries and Soviet Russia are very advanced both in feminist legislation and social outlook. In France is one of the most backward countries. Germany and England taking an intermediate position. In many states in the U.S.A. women have a considerable advantage over men especially in regard to divorce. A prominent U.S.A. organisation is the Lucy Stone League which advocates the retention by women of their own surnames after marriage. Considerable agitation is being conducted in Great Britain over the question of nationality. A British woman marrying a foreigner automatically loses her British nationality and as a rule could acquire the nationality of her husband. If however he happens to be a United States citizen then by the laws of that country she would not be entitled to U.S.A. nationality for a year and not necessarily even then and so would be left stateless for at least that period. The agitation in Great Britain is to secure that British women marrying foreigners shall retain British nationality if they so desire and declare. See also NATIONALITY.

Fences may be *boundary* or *divisional* structures. Their original purpose was to confine farm animals and to exclude wild cattle from cultivated land. Every owner is bound at common law to prevent his cattle from straying on to the land of others. Fencing must be built on the boundary line between two adjoining estates if the two owners agree in wanting a dividing fence. If one only wants a fence he must erect it on his own land. Permanent fences are usually made of hedges or low stone walls (see TIMBERS).

Wire is largely employed in fencing land with wood or iron straining posts sunk in the ground and intermediate standards usually made of larch wood. Wood posts should be treated with creosote to prevent decay.

Live Fences serve the double purpose of enclosing land and giving shelter in some degree. The common hawthorn is most often used on account of the stiffness of its branches and its thorns and its winter hardiness. The bushes should be planted when 1 ft high with a root depth of 1 ft in prepared ground and first trimmed after 4 years.

Fencing. Originally the art of attack and defence with sword or rapier in single combat the word is now usually applied to friendly contests for sport with blunted weapons. The sword and buckler combats of Tudor times were superseded at the end of the 16th cent. by combats with the Italian cut and thrust rapier and dagger which in turn gave way during the 17th cent. to the French small sword the point only being used from this weapon the modern fencing foil and *épée de combat* are derived.

Fencing as a sport is divided into 4 main divisions according to the type of weapon used: *foils épée de combat sabres* and *singl. stick*. In all cases wire masks gauntlets and white padded jackets are worn by the combatants. In *foil fencing* only hits correctly made on the body are counted accidental hits or hits on the

face or limbs, being disregarded. The French foil has a quadrangular tapering steel blade, c 33 in in length from guard to button, with an 8-in handle, and a light metal guard shaped like the figure 8. It weighs c 1 lb. The thicker part of the blade near the guard is called the *forte*, the thinner front portion the *foible*. The Italian foil is slightly longer, and has a bell-shaped guard with a cross-bar, with which the fore-finger is interlocked. The French foil is lightly held with the palm and fingers, the thumb resting on the upper side of the grip. The principal form of attack, called the *lunge*, is made by extending the right arm so as to bring point, hand, and shoulder into one straight line, at the same time advancing the right foot and straightening the left leg. The extension of the arm should slightly precede the movement of the right foot. The part of the body on which hits may be scored is called the *target*, and is divided into 4 sections, the 2 upper quarters being known as the "high lines," the 2 lower as the "low lines." There are 8 recognised *parries*, 2 in defence of each quarter of the target, 1 in each case being made with the thumb upwards ("supination"), and 1 with the knuckles up and thumb down ("pronation").

The parries are known as *prime*, *seconde*, *tierce*, *quarte*, *quinte*, *sixte*, *septime*, and *octave*. Sixte and tierce defend the right "high line", quarte and quinte the left "high line", octave and seconde the right "low line", septime (or *demi-epee*) and prime the left "low line". The first of each pair is made in "supination," the second in "pronation." The most important parries are quarte and sixte. Parries are made by a quick beat of the "forte" of the blade on the adversary's "foible," but in making counter parries the point describes a narrow circle, catelung and turning aside the opponent's blade.

The names of the parries are also applied to thrusts and engagements,

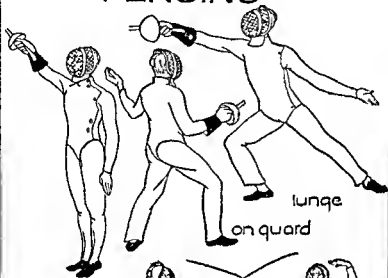
e.g. a thrust at the upper left breast is said to be a thrust in *quarte*. Attacks are made by the *lunge*, described above, the *disengagement* (i.e. dropping the point under adversary's foil, followed by a lunge on the other side), the *cut over* (i.e. passing foil over adversary's blade), and the *riposte*, a thrust delivered immediately after a successful parry. Attacks made when the adversary is on the defensive are called *primary attacks*, *secondary attacks* are made while the adversary is preparing or developing an attack, or on the conclusion of an unsuccessful attack. Every attack must be parried, and a *stop-thrust*, or counter-thrust without parry, is invalid if the thruster receives a touch on any part of his person. *Force attacks* follow a blow or pressure on the adversary's blade to force it aside and make an opening for a lunge.

Epee-fencing, an attempt to reproduce the conditions of actual duelling in which hits are counted on any part of the person, was established in France c 1880, and introduced into England in 1900, in which year the *Epee Club* was founded. The *epee* is longer and heavier than the foil (c. 35 in long, and 1½ lb in weight), and has a bowl-shaped guard.

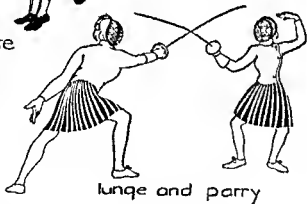
Sabre-fencing a form in which both edge and point are used. Various types of weapon have been used, based on the different kinds of cavalry sabre, but since the beginning of the 20th cent the light Italian sabre, c 34 in long, and slightly curved, has been almost universal. Hits count on any part of the person above the waist and on the outside of the thighs. The two principal parries are *tierce*, as described under foil-fencing, and a high hanging parry made with a crooked arm.

Single-stick Fencing with a round ash stick, c 34 in long with a basket hilt, originated in the 16th cent, when it was used as a practice weapon for the broad-sword. Single-stick was extremely popular in the 18th cent under the name of "cudgel-play," and was practised in the 19th cent. on

FENCING



salute

lunge
on guard

lunge and parry

engagement
inengagement
in sixte

much the same lines as sabre-fencing, but it has largely been neglected since the introduction of the light sabre

Fénelon, François de Salignac de la Mothe (1651-1716), French writer, mostly on theological subjects, was tutor to the son of Louis XIV (1689-97), for whom he wrote his *Fables*, the *Dialogues of the Dead*, and *Télémaque*. His *Maximes des Saints* led to his condemnation by the Pope, who ordered him to vacate his Archbishopric of Cambrai (1690). He was a strong opponent of Jansenism, and a close critic of the politics and literature of his time.

Fêng Yu-Hsiang (b 1880), Chinese "Christian general". He served in the Chinese revolution, and, as commander of the 11th Division, was Governor of Shensi, 1921, and Chief of the NW frontier defence, 1923. He installed Tuan Chi-jui as President in place of Tsao Kun in 1924, and was an active administrator on behalf of the Nationalist Government until expelled from the Kuomintang in 1929.

Fenian Brotherhood, or *Fenians*, an Irish revolutionary society organised in America, by Stephens, in 1858, and introduced into Ireland in 1865, to bring about its separation from Great Britain; it collapsed after c 1867.

Fennec, the smallest of the foxes, a sandy-coloured species, distinguished by its enormous ears and found in the Sahara.



Fennec

It lives in burrows, is nocturnal, and feeds upon jerboas (*q v*), lizards, small birds, and the like.

Fennel, plant belonging to the family Umbelliferae, with an erect stem 2-3 ft. high, numerous leaves deeply divided into soft hair-like segments, and large terminal umbels of yellow flowers. The plant is aromatic, and the chopped leaves are often used as an ingredient in sauce for fish. Fennel is common on waste ground,

especially near the sea. It flowers in July and Aug.

Fens, a low-lying district in the E. of England, around the Wash, and including portions of the counties of Cambs, Hunts, Lincs, and Norfolk. Area c 2000 sq m. The chief rivers are the Ouse, Welland, Cam, Nen, and Witham. There are many drainage canals and streams. Parts of the land are marshy. It is supposed by some that the fens were originally a forest area which was inundated by a great tidal wave, and that the Wash is all that remains of the huge bay so formed. The Romans were the first to attempt drainage, and a number of subsequent efforts were made, of which the most notable was that of the Earl of Bedford in the 17th cent., who reclaimed the district of Bedford Level. From the late 18th to the 19th cent. drainage was steadily continued. To-day, the Wicken Fen is the only remaining natural fen; the rest, though comprising many swampy parts, forming a rich agricultural district.

Feoffment, in feudal times, a transfer of freehold land by appropriate words and *livery of Seisin*, i.e. delivery of possession. This method was gradually superseded by transfer by deed.

Feræ Naturæ (Eng. law), beasts and birds of a wild disposition, e.g. deer, pheasants, hares, as distinguished from those *domitæ naturæ*, i.e. domestic animals—cows, dogs, poultry, etc. They are not, while living, the subject of absolute property, and therefore cannot be the subject of larceny. But a qualified property may be acquired if and so long as they are tamed, or while too young to fly or run away, or when there is a privilege of taking game. The owner of a savage animal, e.g. a tiger, is responsible for any damage done by it, but not the owner of a naturally gentle animal, unless he knew it to be of a savage disposition. See also Dogs.

Fer de Lance (or *Rat-tailed Snake*), one of the species of so-called pit vipers

found in the W. Indies and tropical America where it is dreaded on account of its fatally venomous bite. It may reach a length of c. 6 ft. and is variously coloured but usually reddish yellow with irregular dark bands and spots.

Ferdinand I (1503-1564) Holy Roman emperor, brother of the Emperor Charles V, claimed the kingdoms of Bohemia and Hungary by right of marriage (1526). He acquired Bohemia but John Zápořka supported by the Turks disputed his claims to Hungary and the territory was divided. Ferdinand became emperor in 1558 and strove in vain to unite Roman Catholics and Protestants. — **FERDINAND II (1578-1637)** became king of Bohemia (1617) of Hungary (1618) and emperor in 1619. His suppression of Protestantism in Hungary and Bohemia resulted in his deposition in Bohemia (1619) in favour of the Elector Palatine Frederick V and the commencement of the Thirty Years War. — **FERDINAND III (1608-1657)** King of Hungary 1625 and Bohemia 1627 succeeded his father Ferdinand II as Emperor in 1637. He had replaced Wallenstein as commander of the imperial armies in 1634. The decline of the Catholic cause in the Thirty Years War forced Ferdinand to agree to the Treaty of Westphalia (1648).

Ferdinand I (1793-1875) Emperor of Austria succeeded his father Francis I in 1830. He proved incapable of ruling and the government was carried on by a council of state. He was forced to abdicate in 1848.

Ferdinand I (b. 1801) former Tsar of Bulgaria was elected to the throne as Prince in 1887 and was proclaimed Tsar in 1908. He led the Balkan League in its attack on Turkey in 1912 but his gains were diminished after the war with Greece, Serbia and Rumania the following year. In 1916 he sided with the Central Powers against the Allies and drove back the Serbians and Rumanians but was

forced to abdicate in favour of his son Boris after the collapse of 1918.

Ferdinand, Spanish kings

FERDINAND I (d. 1065) the Great became King of Castile in 1028 and acquired Leon ten years afterwards. He began the campaigns of reconquest against the Moors and assumed the title Emperor of Spain in 1056.

FERDINAND III (1199-1252) the Saint King of Castile became King of Leon on the death of his father Alfonso VII (1231) and permanently united the two kingdoms. He drove the Moors back to Granada, persecuted the Albigenses and codified the Latin and Gothic laws. He was canonised in 1671.

FERDINAND V King of Castile and Leon and II of Aragon (1452-1516) was the first king of united Spain. He married Isabella of Castile, patroness of Columbus. Ferdinand drove the Moors from Granada, conquered Naples and Navarre and (1480) established the Inquisition at Seville.

FERDINAND VI (1713-1759) King of Spain maintained a neutral policy during the Seven Years War between England and France and aided by his ministers Carvajal and Ensenada revived Spanish art and literature.

FERDINAND VII (1784-1833) King of Spain succeeded Charles IV in 1808 but was forced by Napoleon to abdicate. He regained power in 1814, rejected the democratic constitution of 1812 and ruled as a despot. Spain lost her American colonies through his misgovernment and his repeal of the Salic law in favour of his daughter Isabella II gave rise to the Carlist wars.

Ferdinand I (1865-1917) King of Rumania married Marie, daughter of the Duke of Edinburgh. He succeeded his uncle Charles I in Oct. 1914. Rumania joined the Allies in 1916 and after his country had been evacuated by the invading armies of the Central Powers, Ferdinand dispatched forces to oppose Béla Kun, the Hungarian Communist dictator.

1919 He was crowned king of Greater Rumania in 1922 and introduced land reforms and universal suffrage

Ferdinand II (1810-1859), King of the Two Sicilies, a despotic ruler who, after granting a constitution, ruthlessly suppressed the Sicilian revolt of 1848. In 1861 England, at the instance of Gladstone, intervened on behalf of his political prisoners in Naples

Ferdinand IV (1751-1825), King of Naples, also king of the Two Sicilies, was influenced by his wife, Maria Carolina, daughter of the Empress Maria Theresa, to declare war against revolutionary France (1792), and was driven from his throne. He returned in 1799, but after Austerlitz, Napoleon (1805) crowned his brother, Joseph Bonaparte, King of Naples. Ferdinand regained power on Napoleon's downfall (1815) and, aided by the Austrians, established a despotic monarchy

Ferghana, district of S Asiatic Russia, including a high range of mountains (reaching 12 000 ft) in the N, and a valley in the S, noted for its fertility, and equable climate. Rice, cereals, and fruit are produced. It has been occupied by Persians, Arabs and other races, and is now in the Soviet Socialist Republic of Uzbekistan. Pop 690,000

Fergusson, Robert (1750-1774), Scots poet whose works had much influence on Robert Burns, is known for his contributions to *Ruddiman's Weekly* and for *Auld Reekie*, a poem describing the literary club to which he belonged

Feringhi or **Feringhee**, an Eastern name for Western people, dating from the Middle Ages, probably derived from "Frank," and usually employed in a derogatory sense

Fermanagh, a county of Northern Ireland, bounded by Donegal on the N, Tyrone on the N and E, Monaghan on E and S, Cavan on the S and W, and Leitrim on the W. It is bisected N.W. to S.E. by the R Erne, which broadens into the two famous loughs of Erne and Upper Erne. To the N.E. the land is low, but W. of

both loughs there are considerable hills, including Culeagh (2200 ft), Belmore (1300 ft.), and Dooham (1250 ft). The county contains a number of beauty spots, notably the two loughs where there is excellent fishing, and the falls of the Erne. The main occupations are agriculture, stock-rearing, and dairy-farming. Iron and several kinds of stone occur in small quantities. There are small manufactures of linen and rough pottery. Fermanagh became an Irish county in the 16th cent. The chief towns are Enniskillen, the county town, and Newtown Butler. Area 650 sq in, pop 57,000

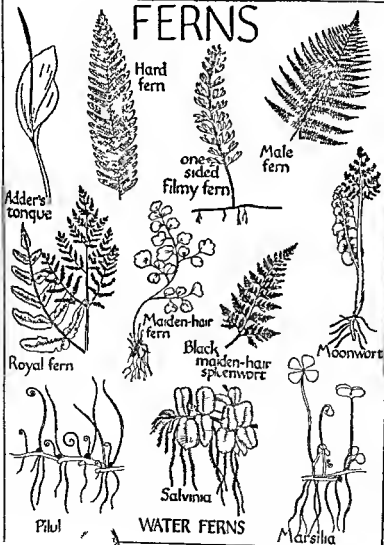
Fernandez, Juan, Spanish navigator, in c 1570 he put out from the coast of Spain and touched Peru, whence the trade wind drove him round to Chile in 30 days. He discovered the islands now named after him, and made an unsuccessful attempt to found a colony, he is said to have located Easter Island and Australia

Fernando Po, Spanish island off the coast of French Equatorial Africa. It is volcanic, and mainly mountainous, the highest point being Pico de Santa Isabel (9400 ft). There are luxuriant forests, rich in valuable timber. The chief exports are cocoa, sugar-cane, and fruit. The chief town and port is Santa Isabel. The natives are of Bantu stock. The Portuguese navigator Fernando Po discovered the island in the late 15th cent, it was ceded by the Portuguese to Spain, and was at one period administered for that country by England. It is governed by a Governor-General under the Spanish Colonial Office. Area, 800 sq in, pop 24,000.

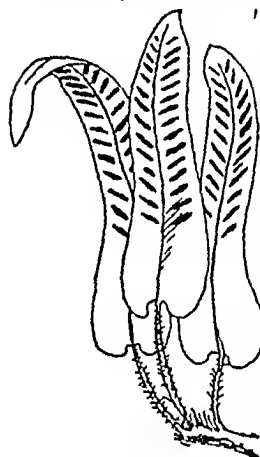
Ferns are the most highly developed of the Cryptogams. The plants of this group show a distinct alternation of sexual and asexual generation. The plant of the sexual generation bears antheridia and archegonia, and the asexual generation develops from the fertilised egg and produces asexual unicellular spores.

The sexual generation resembles a

FERNS



simple liverwort (*q v*). The plant of the asexual generation has a highly differentiated internal structure and an external structure differentiated into stem, leaves, and root. The spores are produced vegetatively in special receptacles on the leaves. The sporangia are stalked capsules, formed of thin-walled cells with an annulus of cells having strongly thickened radial and inner walls. Dehiscence of the sporangium is brought about suddenly: water is lost from the cells of the annulus, and the thin walls of these



Hart's tongue Fern

including *Marsilea*, *Pilularia*, *Salvinia*, and *Azolla*

Propagation Any species of fern that sends out runners, or creeping underground stems, can be readily increased by division. They should never be divided till the parts to be separated are each well rooted. They should then be separated with a sharp knife into as many parts as have roots and a small ball, planted in pots only slightly larger than the ball, watered gently and placed in the shade until established. Several species produce miniature or embryo plants on the fronds. These should be pegged down in a pot filled with suitable soil, and de-

contract till a transverse rupture across the thin-walled cells occurs, and the rapid movement ejects the spores.

Common English ferns are the male fern and hart's-tongue, which grow wild in woods and hedgerows. A curious group are the water-ferns,

tached when the buds have made roots into the soil and put forth several leaves.

Several of the finest ferns cannot be increased by division, but these can be raised from spores. A constantly damp warm atmosphere is required and little if any sunshine.

Soil Ferns require a light open soil. A suitable compost consists of 2 parts sandy fibrous peat, 1 part turfy loam, and leaf-mould 1 part, with a free admixture of sand.

Watering is most essential. Ferns must be kept very damp always, or they quickly die.

Ferozeshah, Battle of (1st Sikh War) (Dec 22, 23, 1845) the British and native troops under Lord Gough defeated 50,000 Sikhs. See SIKH WARS.

Ferrara, N Italy, capital of the province of the same name in Emilia, formerly especially famous for its steel blades. There are manufactures of knitted goods, shawls, and in former years pottery. Savonarola, Tasso, and Ariosto were all born here. Pop. 116,000. Province, area, 1000 sq m, pop., 346,000.

Ferrara-Florence, Council of (1438-45), this Council excommunicated the delegates who remained at Basle. It was later transferred to Florence. Its attempt at reunion between the Greek and Roman Churches was successful only on paper, and was rejected by the Greeks, in spite of the Emperor's attempt to enforce it. With the fall of Constantinople, the unification movement ended.

Ferrari, Gaudenzio (c 1480-1510), Italian painter, born in Piedmont, appears to have studied under Lami at Milan, and won considerable fame in his lifetime, painting numerous frescoes for the churches of the duchy of Milan. Many of these are in small and outlying villages and townships, and his work has not become so well known as that of many inferior artists. His altar-piece in the Church of San Gaudenzio at Novara is one of his finest works; at Vercelli there are series of his frescoes illustrating the life of the Magdalene and of the Virgin,

and other frescoes exist in Santa Maria delle Grazie at Milan. Specimens of his work hang in the National Gallery and in the Louvre.

Ferrel's Law propounded by Wm Ferrel (1817-91). If a body moves in any direction on the earth's surface there is a deflecting force arising from the earth's rotation which deflects it to the right in the N hemisphere but to the left in the S hemisphere. A moving body has a tendency to keep on in a straight line but the movement of the earth drags it from its course and if the velocity of the body were great enough to be perceptible in comparison with the speed of rotation of the earth the body would have an apparent movement in a direction opposite to that induced on the same principle that a man walking on the deck of a ship which is turning rapidly to the right will if he pursues a straight course arrive at the left side of the vessel. The principle applies mostly to wind and to rivers moving nearly at right angles to the direction of rotation and it has been suggested that erosion by rivers is assisted by the earth's rotation which deflects the water against the bank opposite to the direct one in which the earth is moving.

Ferrers Anglo-Norman family. Henry Ferrers a supporter of William the Conqueror was granted estates in the Midlands and Robert his son was created Earl of Derby 1139 a title held by the family till 1608. The barony of Ferrers created in 1499 passed to the Deereux family in 1450 and then to the Shurleys who have been Earls Ferrers since 1711. Walter Knight Shurley 11th and present Earl (b 1804) is an authority on architecture.

Ferret, the albino variety of a domesticated polecat (fer) of which the original wild species is not certainly known. It may be of European, Eastern or African origin. It is used for driving from their borrows rats and rabbits, which are either shot, netted or killed by dogs. When ferrets are partly brown

like the polecat they are called polecat ferrets.

Ferrier James Frederick (1808-1864) was born in Edinburgh and became Professor of Moral Philosophy and Political Economy at St Andrews University. His most important work is *Institutes of Metaphysics—the Theory of Knowing and Being* (1854).

Ferrier Susan (1782-1854) Scots novelist the Scottish Jane Austen. published anonymously several novels that were widely popular and highly esteemed by Sir Walter Scott. In *Destiny* (1831) her humorous style and clever characterisation appear at their best.

Ferrits see IRON AND STEEL.

Ferrochromes, various alloys of iron and chromium employed in the manufacture of steel. The two principal grades have a high and a low carbon content respectively. The alloys are produced by the reduction of chromerone with carbon in an electric furnace according to the following reaction:



See also CHROMIUM STEEL.

Ferro-concrete, see CONCRETE.

Ferry a place at which a regular boat service crosses a river or narrow stretch of sea also a boat so used. The right of ferry and of charging tolls therefor is granted by the King. Special ferries are constructed for the conveyance of cars and trains those for the latter purpose having railway lines on deck so that the train may run on and off under its own steam. One of the best known train ferries is that between Harwich and Flushing.

Ferry Jules François Camille (183-1893) French statesman. A republican leader he was a member of the National Defence Government of 1870 and administered Paris during the Prussian siege. In the third republic he was Minister for Education and for Foreign Affairs and twice Premier 1880-1 and 1883-4. He instituted free secular primary education established the French protectorate in Tunisia sent expeditions to

Congo and the Niger, and organised a campaign in Indo-China Ferry became President of the Senate in 1893, but was assassinated shortly after

Fertilisation, the process of union between a male and female cell, which results in the production of a new individual or a resting cell, which ultimately rejuvenates itself to form one or several new individuals See also REPRODUCTIVE SYSTEM

Fescennine Verses, ancient indigenous Roman songs, composed *extempore*, and recited at rustic merry-makings, particularly weddings They were generally playfully abusive or licentious They are said to have been first employed at Fescennium, a town in S Etruria

Fescue, genus of grasses of which there are c 12 English species, having numerous spikelets, each of several flowers, in a compact or spreading panicle Sheep's fescue is an abundant tufted grass on dry open spaces, of very variable habit, 6 in to nearly 2 ft high, the leaves almost cylindrical, chiefly basal, panicle compact, slightly one-sided Creeping fescue is distinguished by its more or less creeping rootstock, and is common in sandy places Tall fescue, a common grass of damp meadows, 2-4 ft high, flowers in June and July Fescue is a valuable fodder, and sown for lawns, but is not used as an ornamental grass

Fessa, or *Fesse*, see HERALDRY

Fête Nationale, annual French national holiday and carnival celebrated on July 14 to commemorate the fall of the Bastille, July 14 1789 (2) Annual holiday, September 22, commemorating the establishment of the Republican Government

Féts, François Joseph (1784-1871), musical theorist and composer Wrote important theoretical and historical works, and composed operas, church and chamber music, and orchestral works He was director of the Brussels Conservatoire from 1833-71 Founded the *Revue Musicale*

Fetichism, see RELIGION, PRIMITIVE

Fettes, Sir William (1750-1836) a Scotsman who left a large sum for the education of orphans and other unfortunate children The trust funds accumulated till 1804, when the building of Fettes College, Edinburgh, was begun The college, opened in 1876, is conducted on public school lines

Feu (or Few), a gratuitous right to land in return for service In Scotland, a kind of socage tenure, the tenant making a return in money called *feu-duty* or *feu-annual* See also TENURE and FEUDALISM

Feuchtwanger, Lion (b 1884), German-Jewish author, has written plays, poems, and novels In his best novels, *The Ugly Duchess* (1923), *Jew Süss* (1925), and *Success* (1930), he gives a complete history of the period in which his characters live, his powers of description and his sense of drama are amazingly rich He treats in remarkable detail a diversity of characters, who are vivid and alive Feuchtwanger was expelled from Germany by the Nazis in 1933

Feudalism The name feudalism is given to that organisation of society which prevailed in Europe in the early Middle Ages It arose in the chaos of the Dark Ages following the breakdown of the Roman Empire, and in the later Middle Ages gave way before the growth of strong central monarchies. Its main features are those of land tenure and personal service Land was held in return for services owed to an immediate overlord, who in his turn rendered service to his lord in return for his land The result was a society formed like a pyramid, with the King at the apex owing services to no one, or to God alone, and at the base the peasants, whose services were the tilling of their lord's land Societies with similar features have arisen at other periods of the world's history, and these are often called feudal, using the term in a very wide sense, but they differed in many important details from the feudalism of the Middle Ages

Owing to lack of records and to

diversity of local custom the origin of the feudal system is a little obscure. It is clear however that it developed out of the chaotic conditions of the later Roman Empire and the Dark Ages. Civilisation did not entirely perish nor society lapse into absolute anarchy with the downfall of the Roman system of government. When the protection of Roman law and order dwindled away when the Pax Romana gave way to the depredations of barbarian tribes the small men, peasants and small landowners tried to find what protection they could to preserve themselves and their traditions. They looked then for protection to men strong enough to provide some sort of effective resistance to the dangers surrounding them. In the lack of any strong central power society developed into a number of local units depending for protection upon some chieftain powerful enough to hold them together and thus arose the baronial system of administration. A further unifying and protective influence was provided by the Church which was acquiring tracts of land which it could not alienate but the use of which it granted in return for services.

Even at its height feudalism differed in detail from district to district. Diversity of custom and of general conditions brought about many differences in structure. Normandy for example was a strongly centralised duchy and the Dukes of Normandy kept a firmer grasp on their vassals than did most feudal overlords. In England William the Conqueror made his vassals take an oath of allegiance to him direct thus overriding their fealty to their immediate feudal lords and helping to prevent the development in England of strong feudal territories such as Normandy in France.

Yet in spite of its local diversities the feudal system possessed a sufficient unity for it to be described as a whole. Having examined its main features it is now necessary to describe it in greater detail.

In theory the land was the king's; it was granted to certain person in return for services and they in their turn granted land to others in return for other services. The fief or that which was granted in return for services was not necessarily land. It might for example be the right to levy a toll or operate a mill—a valuable privilege in the Middle Ages. The holder of the fief would have to be invested and swear fealty to his lord. As long as he fulfilled his obligations he and his heirs would be secure in the holding of his fief.

The services by which freemen held their land were supposed to be political and honourable not being obtained by the overlord for profit. The services which the serfs gave for their land were very different in character.

There were general services mainly the moral duty of serving one's lord faithfully which might quite easily involve immoral actions towards his enemies. There were also particular services defined either by custom or more rarely in writing. Military service was the most important of these. The vassal would have to be ready to serve in the field and bring with him an armed force according to his position in the feudal hierarchy. Court service was almost as universal. Then there were certain financial obligations and certain rights possessed by the lord. The financial obligations included relief—that is the fine payable by the heir for admission into his succession and aids or financial assistance that had to be given to the lord in certain circumstances such as for his ransom when taken prisoner. Wardship and marriage were lucrative rights possessed by the lord. Under wardship the lord obtained the revenues of a fief when it was in the possession of a minor; under marriage the heiress must marry as the lord wished and his consent could be sold.

In addition to many of these services with the notable exception of military service the serfs had to work on the lord's land. They generally

had to work a given number of days per week, with extra work at certain periods of the year, such as harvest-time. Their services were burdensome, in that they very often took the serf away from his own land when his presence was most necessary.

Feudalism was also a form of government. For the Kingdom, the *Curia Regis* was its main organ, acting as legislature and court of justice. Locally, the feudal courts administered justice, and supervised what little public administration existed. The manorial courts, besides deciding disputes and grievances of the members of the village community, concerned themselves with questions of agricultural practice, and generally governed the manor according to its own, often peculiar, customs.

Gradually this system broke down. The power of the barons became weakened, the services fell into desuetude, and the King's courts took the place of the feudal courts.

There are various reasons for this decline of feudalism. Many of the Kings pursued more or less successfully the policy of increasing their own power at the expense of the feudal barons. The process was slow, and in England not completed until the age of the Tudors. In spite of William the Conqueror's care to avoid giving the barons too much power, England saw several successful risings of the barons against their King, though generally only when the King was very weak. The main line of policy which can be clearly traced is the spread of the King's justice. The establishment by Henry II of trial by jury is a case in point, it is a case of calling in the common man to assist in the administration of justice, in a sphere outside the feudal courts. The decline in the influence of feudal courts was a great blow to the strength of the barons.

But other factors were aiding monarchs in their attack on the barons. The barons were weakening themselves by internecine warfare, as in the Wars of the Roses in England. Economic

changes were bringing to the front other classes on whose aid the King might rely in struggles against the power of feudalism. Trade was increasing, and towns were growing thereby, and becoming more powerful. The Crown encouraged this independence and loyal patriotism by the grant of charters. The merchant class was becoming important. This is seen in the representation of the commons, to a large extent merchants from the towns, in the Parliaments of the later Middle Ages.

Feudalism, then, was the organisation of society in the period lying between the Roman Empire and the rise of modern States, and it remains to assess its value and importance.

It used to be the fashion to regard feudalism as a barbarous form of organisation, only endured because the age had not achieved the enlightenment that produced the Glorious Revolution and the Whig Monarchy. But feudalism has its place in history and its values.

Barbarian invasions broke the power of Rome and cut up the lines of communication upon which that civilisation was largely based. The Western world might very easily have lapsed into complete anarchy and barbarism had not some form of social organisation emerged to give it stability and a medium of peace.

Feudalism had its defects: it gave power to a comparatively few barons, with little or no central control over their activities. Abuse of power was common, and wars amongst the barons themselves distracted the countryside. Yet feudalism did provide a certain amount of protection to the weak.

What order and stability it provided enabled more than the mere remnants of Roman civilisation to be preserved. Had it not been for this Rome might have perished as Babylon perished. It was the Church and the towns that preserved the tradition and culture of Rome, but without some form of more or less stable organisation this could not have been achieved. Feudalism

was a compromise between civilisation such as Rome had known and anarchy and anarchy was the only alternative to that compromise. See also TENDRER

Fen de Joie (FE DÜ ZHWA) originally a thanksgiving or festive bonfire. To-day a musketry salute given on special occasions by the successive discharge of blank ammunition in the air each individual in a rank of riflemen firing rapidly after his neighbour.

Fenerbach Anselm (1879-1880) German painter worked at Paris under a pupil of Ingres. In Italy his own classical inclinations and ambitions were strengthened by his study of the work of the old masters and the ancient sculptors. He later came to be considered the foremost German classical painter. Among his best known works may be mentioned *Dante's Death* (1808) *Iphigenia* (186) and *Orpheus* and *Eurydice* but modern taste finds more to admire in his landscapes and portraits.

Feuillelet, Octave (1891-1890) French author earned great praise and the favour of the Napoleonic Court by his novels and plays. Of the former *Monsieur de Camors* (186) *Julia de Tricœur* (1872) and *Le Roman d'un Jeune Homme Pauvre* (1858) may be mentioned.

Feuilleton part of a newspaper devoted to light literature belles-lettres etc. also more usually that part of a newspaper containing the daily instalment of a serial novel.

Fever an increase in body temperature which accompanies many illnesses. It may even arise following nervous shock. In many diseases however the fever becomes predominant. It is caused by the formation of a poison (toxin) in the system; the product of active bacteria in the blood; the rise in temperature produces an enormous wastage in tissue and the sufferer loses weight rapidly. An attack is usually heralded by violent shivering and a feeling of cold followed by heat, headache and lassitude. Then the tongue becomes dry and furred, pulse and breathing are quick-

ened and there is general nervous disturbance. The fever rises to a crisis or culminating peak and then declines suddenly. See also ENTERITIS ENTERIC BLACKWATER RHEUMATIC and SCARLET FEVER DIPHThERIA etc.

Feverfew of the family Compositae bears numerous small heads of flowers on an erect stem with the lower flowers borne on longer stalk so that the whole inflorescence reaches the same level. The flowers have white ray florets. The leaves are stalked repeatedly cut curled and delicate green and are conspicuous in mid winter. The whole plant has a powerful and not unpleasant odour said to be particularly offensive to bees. The English name is a corruption of *Febri-fuge* from its tonic properties. Common feverfew flowers in July and Aug. growing on waste ground. Corn feverfew or scentless May weed has a branched spreading stem and solitary flowers which are much larger and are distinguished from those of common feverfew by the exaggeratedly convex receptacle. It flowers from July to Oct. in cornfields.

Fez, important town of French N. Africa capital of N. Morocco. The old town has long been a centre of Moroccan learning and piety and contains a university, the Sultan's palace and the Karouein, the largest mosque in Africa. It is a great caravan trading centre lies in the fertile valley of the Wad Fas and has general manufactures of silk and woollen goods, filigree work in precious metals, carpets etc. The French have constructed a modern city just outside the walls of the old Fez. It is believed to have been founded in the 9th cent. and in the 13th and 14th was noted even in Europe as an intellectual centre. Pop. (1931) 107,800.

Fez (n. adgear) see TARRUSH.

Fezzan, roughly defined territory forming the S. portion of Tripolitania. It is within the Sahara Desert and the only fertile tracts lie around the scattered oases where dates, olives

and figs are cultivated, and cotton and grain produced. Camels are reared, and a few cattle and horses. The natives are a mixed race of Arabs, Bornu, and Tuaregs. The capital is Murzuk. Area, c 156,000 sq m., pop., c 70,000.

Fiars Prices, the value of grain in the different counties of Scotland, fixed yearly in Feb. by the respective sheriffs, assisted by juries. They regulate prices where no price has been stipulated at a sale of grain.

Fiat (Lat. "Let it be done"), an order of a judge or law officer for allowing certain processes, e.g. the fiat of the Attorney-General is required in certain proceedings relating to charitable trusts.

Fibre, term applied to a number of thread-like substances. It is usually the result of natural growth, but may be used to describe finely drawn glass and metals.

Apart from asbestos, which is a mineral substance, commercial fibres fall into two classes—animal and vegetable. Of the first class, the most important are sheep's wool, the hair of the camel, or alpaca, mohair from the Angora goat, and silk from the silkworm.

Vegetable fibres are extensively used for textile purposes. Commercially, the most widely employed are cotton, jute, hemp, esparto grass, sisal hemp, flax, and coir, obtained from the outer covering of the coconut. The stiffer fibres are used for brush making, other types for stuffing upholstery. Their most extensive use, however, is in the manufacture of textiles (*q.v.*)

Fibrinogen, see **Blood**.

Fibrom (or *Fibrosin*), an albuminoid protein which forms over 50 per cent of silk. It is obtained by boiling silk with water, when it is left behind as a residue which can be dissolved in concentrated acids or alkalis.

Fibula, see **BRONZE AGE**.

Fichte, Johann Gottlieb (1762-1814), German metaphysician, was born at Rommenau in Lusatia, and educated at Jena University. After a period as

a private teacher in Zurich, he settled at Leipzig in 1789. His *Critique of Revelation* (1792) was written after a close study of Kant, and in an endeavour to please that philosopher. In 1794 he became professor of philosophy at Jena, but four years later a charge of atheism laid against him forced his resignation. He went to Berlin, where he lived until his death, save for an interval in 1806-7, and where he produced several important treatises. In 1810 he became first rector of the new Berlin University.

His philosophy of subjective idealism exercised much influence on Schopenhauer and Hegel, and on many other 19th-cent philosophers. For Fichte the mind of man was wholly dependent upon the divine essence, having, indeed, no existence separately from it. His most important work was *The Science of Knowledge* (1794).

Fichte was largely responsible for the awakening of the national and patriotic spirit in Germany, especially during the Napoleonic campaigns, and to him in great measure is due the success of the Romantic school in the 19th cent.

Fichtelgebirge, Bavarian mountain range, NW of the Böhmer Wald. There are valuable deposits of iron, lead, copper, and marble, which provide considerable employment. Rivers rising in the range are the Weisser Main, Naab, Eger, and Saale. The highest peaks are Schneeburg (3450 ft.), and Ochsenkopf (3350 ft.).

Ficino, Marsilio (1433-1499), Italian philosopher. His father was physician to Cosmo de Medici, who, perceiving the boy's capabilities, determined to bring him up as a Platonist. In 1459 he studied Greek under John Argyropoulos, and in 1482 completed his translation of Plato, prior to which (1476) he had composed a work on Christianity. Ficino was not original, and made the error of confusing Plato with the Neo-Platonists. His minor writings are of more value, for in them we see a reflection of the age of the Medicis.

Fiction a term strictly applied in literature to any form of story whether in prose or verse of which the characters and plot are purely imaginary or one in which historical events and persons are treated in an original and imaginative manner. In practice the term is used only for prose fiction. *See also* NOVEL. SHORT STORY

Fiction, Legal In law something assumed for a special purpose. All early systems of law e.g. the Roman and English are rigid recognising only certain causes of action and no others. Legal fictions are devices for extending the scope of law without resort to cumbersome legislative process that might be defeated by the reverence with which the older lawyers regard the law that has been handed down to them. Thus a plaintiff in Rome would begin by stating that he was a Roman citizen and the defendant would not be allowed to disprove this because otherwise injustice would result from the fact that early Roman law only protected citizens.

Ficus elastica, a tree containing india rubber which is now negligible as a source of commercial rubber. It grows in the E. Indies as a large tree with massive twisted roots and is often cultivated as a shrubby plant in greenhouses for its pink flowers which are conspicuous against the large dark and shiny egg shaped leaves. *See also* FIG and RUBBER.

Fideicommissum (Lat. a charge by way of trust) in Roman law a testamentary disposition by which a person who gives a thing to another imposes on him an obligation binding in conscience but not at law to transfer the whole or a part of it to a third person. It was introduced originally to ensure that a person incapacitated at law from receiving the legacy should nevertheless obtain it.

Fides Defensor *see* DEFENDER OF THE FAITH

Fiduciary Issue, that part of the Bank of England note issue which is not backed by gold and silver coin and bullion. (The silver may not be more

than one fourth the reserve. Actually the Bank of England keeps only a very small amount of silver coin and bullion.) The Fiduciary Issue must be backed by Government debt and securities. The amount is limited by law to £60 millions but this amount may be exceeded temporarily if special permission is granted by the Treasury. This was done from Aug. 1931 until early in 1933 the Fiduciary Issue being for over a year limited to £275 millions. It became necessary because the Bank of England's gold reserve was very low and the community's need of notes as high as ever. Increasing the Fiduciary Issue did not increase the number of notes in circulation but only that portion which was not backed by gold.

On the continent the term Fiduciary Issue is used to mean the total note issue.

Fief, a manor a possession held by some tenant of a superior lord. *See also* TENURE. FEUDALISM

Field, Cyrus West (1819-189) American business man and financier born at Stockbridge Massachusetts U.S.A. In 1834 he was a store clerk and in 1840 founded a paper business from which he retired in 1853. He became interested in the idea of an Atlantic cable approached several American capitalists and in collaboration with Sir Charles Bright and with the aid of Government grants formed the Atlantic Telegraph Company in 1856. A cable was laid in 1858 but proved defective. Relaid in 1866 it achieved an immense success.

Field Eugene (1850-189) American poet was for a time a journalist. He is best known for his poems of childhood and for his translations of Horace *Ech es from the Sabine Farm* (1899). The former are charming and very popular.

Field Artillery *see* ARTILLERY
Fieldfare, a large species of thrush which breeds in N. Europe and is a winter visitor to Gt. Britain.

Field glass, *see* OPTICAL INSTRUMENTS

Fielding, Henry (1707-1754), novelist and dramatist, first became known by his satirical plays, of which the *Author's Farce* (1730), *Tom Thumb* (1731), and *Pasquin* (1736) are examples. After the Lord Chamberlain's licence for plays was required (1737), Fielding's plays were never allowed to be presented, and he turned to novel-writing. His first important novel was *Joseph Andrews* (1742), a parody of Richardson's *Pamela*, in which his faculty of irony became apparent. It is also to be noted in *The Life of Mr Jonathan Wild* (1743), a mock-heroic history. In 1748 he became a justice of peace for Westminster, and in the same year published his greatest novel, *Tom Jones*, which was followed by *Amelia* (1751) and various pamphlets. From Fielding's characterisation of his own times and keen irony and satire, the English novel of the Victorian type (e.g. those of Dickens and Thackeray) derives.

Field-marshal, since 1736 the highest rank in the British Army, a marshal having previously been one responsible for order in court and for supervising the camps of an army in the field. There are at present 11, including the King of the Belgians, the Emperor of Japan, and ex-King Alfonso.

Field Mouse, a general name for wild mice or voles, usually applied to the long-tailed field mouse or wood mouse, a larger species than the house mouse, and more brightly coloured. It is common in England, living mostly in hedgerows and fields, but not infrequently enters country houses, where it may be as great a pest as the house mouse.

Field of the Cloth of Gold, The (*Champ du Drap d'Or*) the site, near Calais, where from June 4 to 25, 1520, Henry VIII and François I of France met. It received its name from the magnificence of the retinues and trains of the two monarchs.

Fields, Grace (b 1898), English variety star. She was born of poor parents at Rochdale, Lancashire, and showed an early talent for popular

musical turns, rising to foremost place in English variety and revue.

Fieri Facias, see EXECUTION

Fiesole, Italian hill town in Tuscany, a few m from Florence. The cathedral dates from the 11th cent and the Palazzo Pretoria from the 13th. In a monastery near by, Fra Angelico lived for several years. Pop (town) c 3000.

Fife, E coast county of Scotland, between the Firths of Forth and Tay, with the neighbouring islands. The surface is composed of low hills; a ridge of hills, including the Comonds, runs from West to East, divided by the valley of the R Eden. Much of the area is fertile, and devoted to the cultivation of dairy and farm produce and sheep and horse raising. There are extensive coal, limestone, and sandstone deposits. The chief industries of Fife are linen, which is the most important, paper, oilcloth, brewing, distilling, and sugar. Engineering and shipbuilding are carried on at Anstruther and Dunfermline. The chief towns are Cupar, the county town, Dunfermline, St Andrews, and Kirkcaldy. Originally, Fife was a separate division, known as *the Kingdom*, there are a number of early Christian and other memorials. Area, 504 sq m, pop (1931) 276,260.

Fife, a smaller form of flute used in Army bands.

Fifth Monarchy Men, a sect of Puritans who appeared in England in 1645, and taught that Christ was about to reappear on earth, to establish a new universal monarchy. In 1653 they held weekly meetings in London at which they denounced Cromwell as "the man of sin," "the dissemblingest perjured villain in the world," in consequence of which he put a stop to their preaching. They reappeared, however, at the Restoration, and stirred up a riot in Jan 1661, in which several lives were lost.

Figaro, celebrated Beaumarchais character, introduced in that author's *Barbier de Seville* and *Mariage de Figaro*. Figaro was a barber, remarkable for his dashing airs and brazen deceptions, whose picturesqueness en-

deared him to the public of the time as well as causing Paisiello Mozart and Rossini to re-introduce him into opera. Mozart's work was entitled *Marriage of Figaro* and Paisiello's and Rossini's *Barber of Seville*. In the latter work the famous aria *Largo al factotum* is sung by Figaro.

From 1818 to 1833 the name was borne by a Parisian journal which was revived in 1854 and which exists today as one of the best known of French daily newspapers. The tone of *le Figaro* is conservative although it passed through an early phase of violence.

Figs, plants of the genus *Ficus*



1. LOWERING PLANT
2. LONGITUDINAL SECTION

woody trees and shrubs from the Mediterranean and Asia Minor. The common edible fig is the fruit of *F. carica*, a small tree with large rough leathery lobed leaves and a hand rough

green branches and almost sessile fruits of peculiar internal structure consisting of a large much-curved receptacle on which are borne numerous unisexual flowers interspersed with hairs. The female flowers are disposed on the base of the receptacle and the staminate on the edge i.e. towards the top. The ripe fruit contains the numerous fertilised female flowers or seeds and the withered stamens and hairs and the receptacle develops succulence. The ancient practice of bringing branches of wild fig in contact with the cultivated tree when its fruits are just formed does in fact improve the bearing qualities of the trees for certain insects which live on the wild plant will enter the immature fruit of the cultivated fig and there fertilise the ovules by carrying pollen from

the stamens on their bodies to the female flowers. Figs can be grown out of doors in the South of England on a fairly rich friable loam which is well drained as standards trained against a wall. The tree produces new shoots twice a year and both these bear fruit buds but only those formed on the late midsummer shoot ripen out of doors. Figs may be grown in pots and forced and a low fruiting season is obtainable if the plants are brought into heat periodically.

Figurehead, bust or figure once fixed to ships' prows underneath the bowsprit. The custom is now obsolete but many examples of figureheads are preserved in shipyards and museums at the present day.

Fig wort (*Scrophularia*) is the genus of flowering plants which gives its name to the Order Scrophulariaceae (see FOXGLOVE FAMILY).

There are four British species which are herbaceous perennial plants attaining a height of c. 4 ft and identifiable by their square stems. The knotted fig wort (*Scrophularia nodosa*) has small greenish purple flowers developed in June and July. The water fig wort (*S. aquatica*) is common on the banks of streams where its withered capsules often entangle the lines of anglers. The balm leaved and yellow fig wort are less common.

Fiji, a group of c. 50 islands in the S. Pacific due N. of New Zealand forming a British Colony. Apart from Viti Levu (4000 sq. m.) and Vanua Levu (7400 sq. m.) they range from a few sq. m. to mere rocks. The group is mainly of volcanic origin and is mountainous with rich vegetation. Large cultivated crops of bananas and other fruit, cotton, sugar-cane and maize. Exports are copra, sugar and fruit. The natives are chiefly Polynesian. There was at one time some cannibalism but this was discontinued years ago. Many of the islands are coral-fringed and there are large coral reefs rendering navigation difficult. Chief towns are Suva, the capital and Levuka. Government is administered

by a Governor, an Executive, and a Legislative Council. Local affairs are largely carried on by native chiefs under District Officers.

Some of the islands were discovered by Tasman in 1643, and others by Captain Cook. They were annexed to Great Britain in 1874. Area, 7000 sq. m., pop. (1931) 185,500 (5000 Europeans).

Filariasis, disease caused by a parasite of the family *Filaridae* (see GUINEA-WORM). The most important species is the *Filaria bancrofti*. It inhabits the lymphatic vessels, and enters the human body from certain mosquitoes. The characteristic symptom of filariasis is the appearance of chyle in the urine, a milky liquid containing minute particles of fat, which is diverted from its normal course to the thoracic duct by the masses of filaria. The general effect of filariasis is malnutrition and inflammation of the lymphatic vessels. See also ELEPHANTIASIS.

Filbert, the nut of a cultivated variety of hazel. The hazel is native to England, the best variety of filbert, the "Lambert Filbert," was introduced c. 100 years ago, and has been widely cultivated since, especially in Kent. The tree thrives on a good open loam, preferably not too deep and is propagated by layers or suckers. It requires careful training if grown to supply nuts on a commercial scale, the branches are usually trained outwards and upwards, to resemble an inverted umbrella, with a diameter of 8-10 ft and a height of 5-6 ft. The trees bear separate female or fruit-bearing and pollen-bearing flowers, and the pollen is carried by the wind. The nuts are ripe when the husks begin to turn yellow—about mid Sept. The yield varies considerably, with an average of 10-12 cwt per acre where the nuts are grown commercially.

Fildes, Sir Luke (1841-1927), English painter, born in Liverpool, who became A.R.A. in 1879 and R.A. 8 years later. He was awarded a knighthood in 1906, and became K.C.V.O. in 1915. The subjects of his

pictures made them highly popular—*The Casual Ward*, *A Widower*, and *The Doctor* are three examples. The last is in the Tate Gallery. He painted the State portraits of Edward VII and George V.

File, a hardened steel rod of flat, square, triangular, or round cross-section, the surface of which is provided with teeth. These are of three principal characters: *single-cut*, consisting of parallel grooves, *double-cut* or *cross-cut*, consisting of two sets of parallel grooves crossing one another, and *rasp-teeth*, single teeth formed by forcing the metal up from the surface into a sharp point. The teeth are cut before the steel is hardened, hardening being effected by heating and quenching in brine.

File-fish (or *Trigger-fish*, so named from the way the first spine of the dorsal fin snaps back when elevated), are bony fishes found mostly in tropical and warm seas, distinguished by their hard mail-like scales, powerful jaws, and teeth adapted for biting through the shells of molluscs and stripping off pieces of coral to get at the soft parts for food. File-fishes may reach a length of c. 3 ft.

Filigree, fine ornamental work of gold or silver wire, closely interlaced. The "Tara" brooch, most famous of Irish filigree work of the 10th cent., was designed with intricate skill from a single long thread. Malta, Scandinavia, Spain in Moorish times, and 12th-cent Byzantium produced artistic workers. Best examples now come from India.

Fihogue Clause, the clause in the Nicene Creed (*qv*) consisting of the words, "and to the Son" (Lat. *fihogue*), referring to the procession of the Holy Ghost (*qv*). It was not a part of the original Creed as accepted by the Council of Constantinople (381, *AD*), but was first added at Toledo at the end of the 6th cent. It thence spread throughout the Western Church, but has never been accepted in the East, and its addition to the creed was one of the reasons alleged by the

Constantinopolitan patriarchs for the breach with Rome in the 9th cent. See EASTERN ORTHODOX CHURCH

Filipescu, Nicholas (1867-1916) Rumanian statesman. A Conservative leader he became Minister of Agriculture and War Minister 1910. He reformed the army, urged Rumanian entry into the war against Bulgaria 1913 and during the World War having united his party with Ionescu's Conservative Democrats effected Rumanian co-operation with the Allied Powers 1916.

Fillet (1) (Dress) A band worn as a headress in ancient times. (-) (Architecture) A band or listel used as a separation for mouldings.

Fillets, the undercuts of pork, beef, veal and mutton. They are usually grilled, baked or sautéed and served with vegetables.

GRENADES are similar to fillets but are larded and braised (qv).

ESCALOPES are similar to fillets but smaller being only $\frac{1}{2}$ -3 in in diameter. They are sometimes coated in egg and breadcrumbs before frying.

Fillmore, Millard (1800-1844) 13th President of the U.S.A. After a career as a barrister in New York he entered the State Assembly and was elected to Congress 1833. In 1846 he became Vice President of the United States with Zachary Taylor as President whom he succeeded in 1850. He resigned in 1853. A Whig supporter Fillmore favoured protection and agreed to the 1850 Compromise Measures regarding slave trade evils including the Fugitive Slave law.

Film (1) A fine thin layer, skin or coating, e.g. a film of oil. (-) Fine delicate filament, e.g. a film of gossamer. (3) Flexible sheet of gelatine or similar material with sensitised surface upon which a photograph is taken, used especially of cinematography (qv), e.g. the films of a film actor.

Filter Press, see CHEMICAL ENGINEERING.

Filtration, the separation of solid particles from fluids by passing the

latter through very fine orifices. A simple form of filter consists of a glass funnel in which a piece of porous paper is placed. The best results are obtained by folding the paper to form a semicircle then folding it so as to divide this into eight, opening it out again and folding the sectors as shown in the diagram so as to crimp the whole piece into folds which can then be opened out to form a fluted cone. The filtration of water to remove bacteria requires care since the filtering medium which must be exceedingly fine frequently becomes a culture bed for the bacteria. The use of charcoal and also of finely divided spongy iron is advantageous as bacteria tend to be destroyed by these agents. For bacteriological purposes filter candles are



frequently employed. These consist of a hollow tube of porous biscuit ware closed at one end and fitted at the other with a glazed porcelain head. They require considerable pressure or suction to force the liquid through them. Filters are also made of finely porous glass produced by grinding glass to a certain degree of fineness and heating it to a temperature at which it fuses together without melting.

Water employed for town supplies generally requires to be filtered, sand being most usually employed for this purpose. Nowadays machine filters are employed the water being forced through the sand by pumps and it is usual to add to the water a material such as sulphate of alumina which, by forming a flocculent precipitate assists filtration.

Air and other gases are frequently

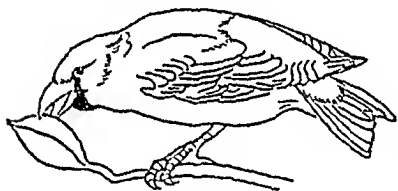
filtered to remove fine suspended particles (see FUME PRECIPITATION) The ventilation of large buildings in towns is best accomplished by pumping air, which has been filtered and brought to the right degree of moisture and the right temperature

Finale, the last movement of a symphony, sonata, etc., or the climax, with soloists and chorus, of an act of an opera

Finance, National, see NATIONAL INCOME AND EXPENDITURE

Finch, a general name for numerous species of small birds referred to an ill-defined family, mostly found in Europe and Central Asia, and distinguished by a stout conical beak, adapted for seed-eating The most familiar species are the following

The *Bullfinch*, known by its thick



Hawfinch

head and neck and the red breast of the cock-bird, and famous as a cage bird for its piping note It has the reputation of being destructive to the buds of fruit trees

The *Brambling*, or bramble finch, which breeds in N latitudes and comes S in winter, often in flocks of thousands The *Chaffinch*, a resident, well-known species, rather less brightly coloured than the last The *Goldfinch*, formerly very abundant, but now comparatively scarce in cultivated districts, owing to the destruction of the thistles and related waste-land plants upon the seeds of which it mainly feeds

These three species are nearly allied, and differ mainly in the brightness and disposition of their black, white, and yellow, or reddish pattern The *Greenfinch* is distinguished by its fairly uniform olive-green hue, and the

Hawfinch is a rarer bird, readily known by its larger size and much stouter bill, its name being derived from the belief in its partiality for the fruit of the hawthorn

Finck, Herman (b 1872), British conductor and composer He began as pianist and violinist to the Palace Theatre in 1892, becoming deputy conductor in 1896 and musical director in 1900, which he remained until he became musical director of the Theatre Royal in 1922 He has written over 50 light operas and revues and hundreds of songs Among his best-known works are *My Lady Dragon-Fly* (1918), *Hullo, America* (1918), *The Song of the Drum* and *Dignity and Impudence* (1931)

Fine, in law, (1) a monetary penalty payable to the State for a criminal offence, which may be inflicted either in addition, or as an alternative, to imprisonment, (2) sum paid for the renewal of a lease, (3) in feudal tenure, sum payable to the lord of a manor by a person on his admission on the rolls of the manor as owner of a copyhold estate

Fine Arts, see ART

Fine Grinding, see CRUSHING AND GRINDING

Fingal, see FINN MAC CUMHAILL

Finger and Toe, see CLUB-ROOT

Finger-prints, see CRIME DETECTION

Finiguerra, Maso (c 1421-1461), Florentine goldsmith, engraver, and draughtsman, closely associated with Ghiberti and Pollaiuolo He was the designer of the five tarsia figures for the sacristy of the cathedral at Florence, and was specially noted for his engraved metal-work (niello) A number of drawings of the school of Pollaiuolo are believed to be his work

Finistère, W coast Department of France between the Bay of Biscay and the W end of the English Channel Large tracts are covered with heath-land, but there are a number of fertile areas which produce vegetables, cereals, flax, cider apples, etc Dairy farming and fishing are important, and quantities of honey are produced

Minerals include slate and clay the lead mines are worked out In the larger towns there are various industries including chemicals shipbuilding machinery leather earthenware etc sardines are canned Brest and Morlaix are the principal ports and towns of note are Landerneau Quimperle and Morlaix Area 2730 sq m pop 753 000

Finland, independent European State since 1917 between Sweden and Russia bounded N by Norway S by the Gulf of Finland W by the Gulf of Bothnia and E by part of Lapland The surface is low lying in the S and W rising in the N and E to the Suari Selka and Man Selka A great proportion of the S and centre is covered with a huge and complicated system of lakes joined by canals Lake Ladoga (of which the S half is Russian) is the largest lake in Europe The whole together with a number of short rivers forms an almost unique inland watersystem For the most part the climate is extremely cold and much of the surface is covered with forest

Agriculture Staple food crops are not sufficient to supply the whole population In order of bulk they are potatoes oats rye and barley

Production and Industry The most important product is timber the allied production of paper the largest industry Smaller industries include iron mechanical chemical and electrical products textiles leather and tobacco The only mineral of importance is granite The broken coast line provides plenty of small harbours which are of value to the large coasting and import trade

Education and Religion Education is compulsory between the ages of 7 and 15 There are universities at Helsingfors (Helsinki) and Turku and a number of secondary technical agricultural and other special schools The predominant religion is Evangelical Lutheranism but complete religious toleration exists

Population and Towns The inhabitants are Finns Swedes Russians

and Lapps a part of Lapland occupying the most N district The chief towns are Helsinki (formerly Helsingfors) (qv) the capital Turku (Åbo) Tampere (Tammerfors) and Vupuri (Viborg)

Government is administered by a President elected by popular suffrage a Council of State appointed by him but acceptable to the popularly-elected House of Representatives Local government is carried on through 9 departments each with a Prefect appointed by the President

History The early inhabitants of Finland were a vigorous and military people whose repeated attacks on Sweden caused a final war (1157) when the Swedes overran the country making it for centuries a buffer State between themselves and Russia The country made steady advances though embroiled in the various Swedish wars until the beginning of the 18th cent when Peter the Great incorporated Finland as a Grand Duchy of Russia Much of the liberty hitherto enjoyed continued until strong efforts were made towards the end of the 10th cent to Russianise the country Thereafter was a period of marked discontent until the outbreak of the World War and a declaration of independence in 1917 Area 134 590 sq m pop (1930) 3 887 000 See also FINNO UGRIAN LANGUAGES

FINNISH LITERATURE

Finlay Robert Bannatyne Finlay 1st Viscount (1844-1919) British lawyer and politician He entered Parliament in 1885 became Attorney General in 1900 and Lord Chancellor under Lloyd George 1916-18 He was British delegate to The Hague Court of Arbitration 1900 and member of the Permanent Court of International Justice

Finnish Language See FINNO-UGRIAN LANGUAGES

Finnish Literature Practically the beginning of Finnish literature dates from the collection and publication in 1820 of the *Kalevala* (qv) which gave a great impetus to the development of a

national literature In 1870 appeared *The Seven Brothers*, an historical romance by Alexis Stenwall, who was also a poet and dramatist Other novlists are Pietari Pääväranta (1827-1913), author of *His Life*, Johannes Linnankoski (1869-1913), whose novel, *The Song of the Blood-Red Flower*, has been widely translated, and F E Sillanpää (b 1888), who wrote an important study of the Red insurrection Juhani Aho (1861-1921) produced beautifully written short stories, such as *The Old Man of Korpela*, and the stories of Aino Kallas (b 1878) have appeared in English translations The chief poets are J H Erkko (1849-1906), Eino Leino (1878-1925), and Larin Kyösti (b 1873)

Finn Mac Cumhail [*pron* MAKÖÖ'L] (*Fingal*), the father of Ossian, and the leader of the *fianm*, or standing army, of Ireland He is the legendary hero of the Irish, Scottish, and Manx Gaelic-speaking nations, and his deeds form an important part of their folklore and national epics—e.g. the account of the elopement of his betrothed, Grainne, with one of his captains, Diarmait O'Duibne A book purporting to be the translation of a Gaelic poem concerning him was published by James Macpherson (*qv*) in 1762 He is supposed to have been killed about A.D. 283

Finn-Ugrian Languages. the designation of a group of languages which includes (1) *Lapp*, (2) *Finnish* and kindred languages of the Baltic area such as *Estonian*, (3) *Mordvin*, a peasant language of many Volga islands, (4) *Cheremiss*, also a peasant language of the Volga and the Urals, (5) the *Permian* languages of the peasants along the R. Kama and Vjatka and in the peninsula of Kola, (6) the *Ob-Ugrian* languages of the central Urals and of certain N. tribes, (7) *Hungarian* It is barely possible that they are remotely related to the Indo-European group They are agglutinative, and have, besides, a very great number of inflectional endings They form a very wide

group, the relation between Finnish and Hungarian, for instance, being hardly closer than that between English and Bengali (*See* LANGUAGES)

Fins, expansions of the skin or body wall, or the equivalent of limbs, by means of which aquatic animals preserve their balance or swim In fishes they are of two kinds—paired and unpaired The paired fins correspond to the limbs of higher vertebrates and have a bony skeleton, and the two pairs are situated primitively one at the front end of the body, behind the gill-slits, and one at the hinder end, being called respectively the pectoral and pelvic fins In some of the higher bony fishes the pelvic fins move forward until they lie on the throat, or they may altogether disappear The unpaired fins are folds of skin into which extensions of the body wall project as fin-rays, which may be stiff or spiny They consist usually of one, sometimes two, dorsal fins on the back, a caudal fin round the extremity of the tail, and an anal fin set far back on the underside The fins of the body are used mainly as balancers to prevent rolling over in the water The tail and its fin serve to propel the fish by side-strokes, and are modified in three different ways The vertebræ may run straight to the end of the body, the fins above and below being equal and meeting just beyond the point of the tail This type of tail is called "diphycercal," or sometimes "protocercal," because it is believed to be primitive It is found in the young forms of many true fishes, in the lamprey and, as a possible modification of the next type, in the lung fishes In this second type the tail end of the vertebral column is bent upwards, and its upper fin consists of a low crest, but the lower fin somewhat behind the tip of the tail is developed into a conspicuous lobe This type of tail seen in the sharks and sturgeons for instance, is called "heterocercal," because its two parts are unequal, the upper, containing the upturned tail vertebræ, being much

longer than the lower lobe. The third type characteristic of all ordinary bony fishes is called *homocercal* because it consists usually of two equal lobes. Nevertheless the upturned bones of the tail show that both these lobes of the tail fin belong to the lower side of the tail and that the homocercal tail is really an extreme modification of the heterocercal tail.

Finsen Niels Ryberg (1860-1904) Danish discoverer of the curative properties of light and inventor of the Finsen lamp. He was born in the Faroe Islands and lived for some time in Iceland. He held a post in the Copenhagen University devoting himself to research on the actinic rays of sunlight which he found could be used to cure skin diseases. In 1896 he published his discoveries and in 1897 his *Treatment of Lupus Vulgaris by Concentrated Chemical Rays* an account of the effect of ultra violet rays. The Finsen Light Institute founded in 1896 has treated thousands of skin disease cases. Finsen received the Nobel Prize in 1903.

Finsteraarhorn [FIN STER AIR HORN] Alpine peak the highest point in the Bernese Oberland (14,030 ft.)

Fin whales see *Rocqual*.

Fiord see *GEOGRAPHICAL TERMS*.

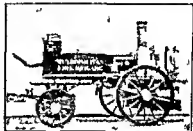
Fiorenzo di Lorenzo (1440-1521) Italian painter of the early Umbrian school. Fiorenzo may have been a pupil of Botticelli and was probably the master of Pinturicchio. He was born at Perugia and there are a large number of paintings attributed to him in the Pinacoteca of that town but only two of the are definitely authentic. His work is chiefly remarkable for the excellence of his landscape backgrounds. Two of his works are in the National Gallery.

Firdous (*Abu'l Kasim Mansur*) (840?-1030?) Persian poet author of the epic poem *Shahnamah* (the Book of Kings) which is a history of Persia containing 60,000 verses. For these Firdous received 60,000 silver pieces although he had been promised one gold piece for every verse and he

wrote a satire on the Sultan for breaking his promise. As a result he had to flee the country. The poem is the national epic of Persia and one episode that of Sohrab and Rustum was used by Matthew Arnold in his poem of that name.

Fire is the name given to the rapid liberation of heat by the chemical combination of various substances with the oxygen of the air a process known as *combustion* (q.v.). We shall deal in this article with the methods of preventing and fighting undesired combustion.

A very important means of defence rarely used in private houses but usual on important business premises is the *automatic alarm* which can be an

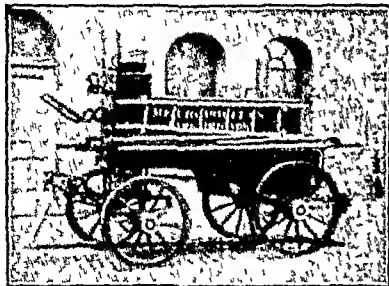


The first horse-drawn team, given London Fire Brigade 1860.

alarm to ring when fire occurs. This apparatus is usually worked by providing strips of metal which when heated bend and make (or break) an electric contact. Installations of this kind should be tested at regular intervals and are preferably made in such a way that if the battery fails an alarm is given. An extension of this principle is the sprinkler installation in which the building is provided near all the ceilings with piping connected to the water supply. Sprinkler heads are so arranged that they open as soon as their temperature exceeds that normally possible in a room and discharge a shower of water. An alarm is given automatically as soon as the system comes into action.

Fire brigades are now maintained by

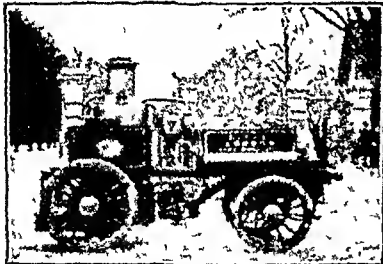
public means in most civilised countries, such institutions go back to very early times. The rise of *fire insurance* in the 18th cent, and the destruction of



Manual engine in use till the end of the 18th cent. These machines had 2 single pump barrels, and delivered 100 gallons of water per min, worked by 23 men on the side levers

the Houses of Parliament by fire in 1834, led to the establishment of well-equipped fire brigades, which were then taken over by the Metropolitan Board of Works, and by similar statutory authorities in other towns. The organisation of fire protection is still a local matter, but there is a strong movement in the direction of national organisation, the modern motor-driven engine and escape being mobile enough to operate over a large area.

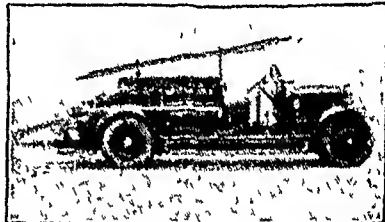
Fire engines were operated by hand



First automobile fire engine, used by the London Fire Brigade, 1904

until the beginning of the 19th cent, when steam pumps drawn by horses were introduced. Piston pumps (see PUMPS) were at first universal, but the

high speed of internal-combustion engines has led to these being to a large extent superseded by rotary gear or centrifugal pumps. Steam-propelled fire engines were being developed when the success of the internal-combustion engine, which can start up from cold immediately, led to its general use both for propulsion and for pumping. Chemically operated apparatus similar in principle to hand fire extinguishers is also in use. A solution of bicarbonate of soda is provided, and, separated from it, an acid substance such as sulphuric acid or aluminium sulphate, which can be mixed with the bicarbonate when required. This generates gas, the pressure of which can be used to throw the liquid to a considerable distance. When alu-



Modern motor turbine fire engine, as used by the London Fire Brigade

minium sulphate is present, the liquid forms a very tenacious froth, especially if a suitable substance for stabilising the froth is added. The chemicals can also be carried dry, and fed into the hose stream from the fire-engine, whereby masses of foam are caused to issue from the nozzle.

A very important development is the *telescopic fire escape*, which has been gradually developed out of simple sliding and folding ladders into the motor-driven turn-table escape in use to-day. This travels under its own power, which is also available on location for elevating the ladder and revolving it so as to bring it into any desired position. Such ladders are constructed to extend to a height of 100 ft. They are also used to enable a fireman to direct water downwards

from a hose upon the fire from a height above it

Fire-arms (law) By the Fire-arms Act 190 with certain exceptions a person is forbidden to possess use or carry any fire-arm or ammunition unless he holds a fire arm certificate this costs 5s and should be applied for at the local police station before the fire-arm or ammunition is acquired No person not registered as a fire arms dealer may make sell or repair fire arms or ammunition and these may not be sold to or repaired for anyone unless he produces a certificate Air guns and air pistols are not within the Act unless declared to be specially dangerous weapons discharging noxious liquids gas etc are prohibited The penalty for holding any fire arm or ammunition without a licence is a fine not exceeding £50 and/or 3 months imprisonment See also GAME GUN

Fire-brat, a wingless insect closely related to the silver fish (qv) and found in bakehouses and kitchens in N America

Fire-clay a clay used for making refractory articles such as fire bricks and crucibles required for use at high temperatures It is found in many parts of England and abroad See also CERAMICS CLAYS

Firedamp, the name given by miners to the explosive mixture of the hydrocarbon methane (qv) with air which sometimes occurs in coal mines Methane is sometimes liberated among other gases from pockets in the coal For this reason naked lights are excluded from mines

Firefly a beetle nearly related to the click beetle (q) and famous for its luminosity which is mainly emitted by two organs on the thorax visible as

yellow spots when not in use Parts of the abdomen however are also luminous The light is so intense that it



Firefly

is possible to read by its aid and the sight of a swarm of these glowing insects dancing in the S American forest at night greatly impressed the earliest travellers

Fire Insurance see INSURANCE

Fire of London, The Great Broke out at

London Bridge Sept 2 1666 and raged until Sept 6 London was reduced to ashes from the Tower to the Temple and from the Thames to Smithfield

Fireproof Cement, see ADHESIVES

Fire-proofing the im-

pregnation of inflammable materials generally with substances which reduce the speed at which fabrics generate inflammable gas when heated Some of the substances used also generate a gas which impedes combustion The formulae comprise mixtures of ammonium chloride ammonium sulphate ammonium phosphate borax boracic acid sodium tungstate Epsom-salts and salts of titanium any of which substances in sufficient quantity will prevent most textiles and similar substances from taking fire All such mixtures should have an addition of starch to fix the chemical The amount of salt used will depend upon the cost and the extent to which the fabric may be stiffened No useful effect can be produced without some disadvantage to the qualities of the fabric

The fire proofing of wood has been the subject of an enormous amount of experiment Thorough impregnation with any of the above salts greatly reduces inflammability best results



The New London Bridge erected commencing 1863 and completed 1876

being obtained under pressure with phosphate of ammonia and boracic acid. No process of impregnating wood is effective without pressure or vacuum, and there is little use in attempting to fireproof woodwork already constructed, though many paints advocated have some slight effect. The best guarantee against fire is the use of non-combustible materials, and these are coming more and more into use in building.

Fireship, a small vessel, filled with inflammable material, lighted and set adrift among an enemy's ships in order to fire them. Fireships were used in classical times, they were successfully employed against the Duke of Parma by the defenders of Antwerp in 1585, and by the British against the Spanish Armada off Gravelines in 1588. British fireships did considerable damage among the French fleet, and Greek fire-ships among the Turks, as late as the early 19th cent. They were rendered obsolete by the invention of iron ships.

Fireworks, see PYROTECHNY.

Firman, a written order issued by the Sultan of Turkey, comparable to the Tsar's *ukase* in Imperial Russia.

Firs (*Abies*) are mainly trees of pyramidal habit, with erect cones which mature in one season. The leaves are solitary and flat, and the scales of the cones are deciduous. Venice turpentine is the product of *Abies pectinata*, the silver fir, and Canada balsam is obtained from *A. balsamea*, Balm of Gilead fir, and *A. canadensis* or hemlock spruce. Common frankincense and burgundy-pitch are yielded by *A. excelsa*, Norway spruce fir. Essence of spruce, used in making spruce-beer, is got by boiling in water the leaves of the black spruce (*A. nigra*). Ornamental species of fir include the Japanese, Nikko, Douglas, Colorado, Noble, Silver, Caucasian, and Spanish. Ordinary soil or calcareous sites suit these trees. Glaucons, green and silver characterise the foliage. See also CONIFERÆ.

First-aid, simple treatment to relieve pain until medical attention is

available, in cases of sudden illness, accidents, poisoning. Much can be done in emergency without special equipment, but a First-Aid outfit of bandages, disinfectants, and drugs increases the range and efficiency of treatment.

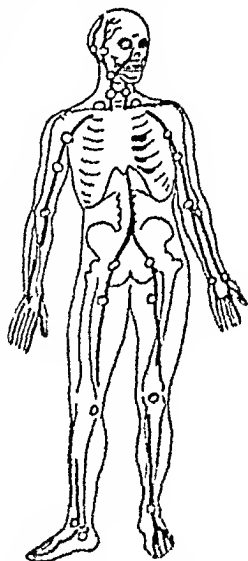
Apoplexy. The person affected falls insensible with flushed and swollen face, breathing deeply, the pupils of the eyes are insensible to light, and contracted, often to unequal size. Lay patient in a horizontal position. Remove tight garments, and apply cold damp cloths to the head. Open windows for a current of fresh air.

Bandaging. Triangular bandaging is used for broken bones, and rolled for holding liniment, lotion, or ointment in position over cut, bruise, or sprain (qqv).

Bleeding or Hemorrhage.

A deep cut with bright red blood coming out in jerks indicates that an artery has been damaged. Lengthy bleeding may be fatal, and must be stopped by pressure at the correct pressure point, shown in the illustration.

Bleeding from the Nose. Apply cold cloth or metal to the nape of the neck and to the forehead. **Bleeding from the Gums**. This may occur after tooth extraction. Lay a pad of gauze across the cavity and press down by closing the jaw gently upon it. **Bruise**



Apply tincture of Arnica or if there are signs of a sprain lead and opium lotion on pads of boracic lint. A cold water compress is good. *Bullet Wounds* Hemorrhage and fractures should be treated as such. Then place boracic lint soaked in cold water or a cold boracic lotion over the wound. To relieve general shock give hot drinks if no damage has been done to the stomach intestines bladder or kidneys. Spirits may be given where there is no hemorrhage. *Burns* Cover the damaged area immediately to exclude air. Apply olive-oil lard caron oil (equal parts of lime water and raw linseed oil) or a solution of baking soda (1 level tablespoonful to 1 pint warm water) on a soft cloth or cotton wool. Preparations containing picric or tannic acid are sometimes used but the former applied over large areas may set up inflammation the latter lessens the tendency to scar. Hot water bottles applied to various parts of the body help to reduce general shock.

Choking Attempt to remove any obstruction in the throat with one finger. A child may be held across the knees and slapped or squeezed across the back or held upside down. False teeth which have been swallowed can sometimes be dislodged by laying the sufferer across a chair with his hands on the ground. Artificial respiration (see under DROWNING) should be applied in cases where the patient has become senseless and blue. Dipping a child in a hot bath (110 F) for half a minute and applying cold water to the head and chest may remove congestion.

Camp see under CRAMP

Cuts Wash with boiled water and apply tincture of iodine. Bandage well.

Downing Apply artificial respiration. Place the patient face downwards fold a coat and place under the lower part of the chest, kneeling astride the patient place the hands below the ribs on either side of the body press downwards gradually

compressing the chest allow to expand and continue thus rhythmically imitating the action of breathing. When respiration is restored place a hot water bottle in the armpit between the thighs and at the feet. Give hot water hot coffee or weak spirits.

Eyes Grit in the eye. Do not rub but lift the eyelid gently and remove the grit with one corner of a soft cloth or a clean camel hair brush moistened with water. Should lime splash into the eye wash thoroughly with vinegar and water (1 teaspoonful to 1 gill). A drop of olive or castor-oil will remove soreness.

Fainting To prevent fainting put the head between knees get into fresh air and drink cold water or a small dose of sal volatile. To hasten recovery lay the sufferer on the floor loosen tight clothing open the windows and dash cold water over the face and hands.

Fractures In compound fractures when surrounding flesh and arteries have been damaged apply a pad of boracic lint soaked in cold water or cold boracic lotion to the exterior and endeavour to set the bones in a natural position keeping them in place with a splint (qv). In carrying a patient with a broken leg up or down hill keep the feet upwards.

Hiccups are caused by indigestion any remedy relieving this will stop the spasms as a few drops of sal volatile or a little bicarbonate of soda in water.

Hydrophobia If bitten by a dog suspected of rabies apply a ligature above the wound to prevent bleeding and bathe with carbolic acid. Consult a doctor as soon as possible.

Hysterics Yawning stretching alternate laughing and crying apparent suffocation swaying of the body and tight clenching of the fingers are all symptoms of an hysterical fit. Firm treatment the loosening of tight underclothing and the application of a douche of cold water to the face with the threat to repeat it will generally end an attack.

Palpitation Unduly strong beating

of the heart may be due to indigestion, when sal volatile and bicarbonate of soda will relieve. Lay down the patient in fresh air, with head and shoulders raised. *Poisoning* Slight poisoning is sometimes relieved naturally by acute vomiting and diarrhoea, or, in gas poisoning, by choking and panting. Empty the stomach by an emetic, or by tickling the back of the throat. A good emetic consists of 2 tablespoonfuls of salt in a tumbler of warm water, or 1 teaspoonful to 1 tablespoonful of mustard in $\frac{1}{2}$ pint of warm water. Poisoning by a corrosive cannot be relieved by an emetic as this would cause further damage to mouth and stomach. Most poisons have an antidote, which counteracts the acid content. In all cases of poisoning the drinking of water, milk, strong tea, or eggs beaten up with milk in water, will minimise the ill-effects. Below is a list of the most common poisons and their treatment.

Scald Remove clothing and apply

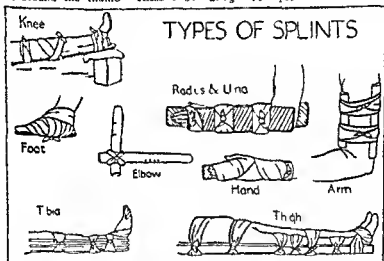
cloths which have been dipped in a solution of baking soda or moistened boracic lint.

Splints A stick, piece of wood, or any other rigid object may be used as a splint, strapped beside a broken bone, to keep the broken ends in a normal position. With a compound fracture, where the bone protrudes through the skin, the splints should be arranged so that the limb retains that position. Padding with tow, wool, hay, or crushed paper will prevent pressure, and give greater comfort. A reef-knot will tie the bandage firmly. For the top part of the arm, four splints are required, three almost the length of the arm from shoulder to elbow, and one shorter to be placed under the arm. The arm should be supported in a sling (*qv*). For the elbow use two pieces of wood, one reaching from the armpit to below the elbow, and the other slightly longer than the forearm and hand. Join together at

Poison	Emetic	Antidote	Treatment
Ammonia	No	Vinegar or lemon juice in water	Drink olive-oil or medicinal paraffin
Arsenic	Yes	Magnesia	} White of egg in water or milk.
Carbolic acid (Cresol, lysol, etc.)	No	$\frac{1}{2}$ oz. Epsom salts dissolved in 1 pint milk	
Caustic soda, caustic potash	No	Vinegar or lemon juice in water	Stimulants if in state of collapse.
Corrosive sublimate (mercury)	Yes	White of egg in water	Drink milk
Iodine	Yes	Starch or flour and water	Barley water
Matches (phosphorus)	Yes	A pinch of copper sulphate, if available	<i>Oils must not be given</i> Give gruel, barley water
Metal polishes (oxalic acid)	No	Magnesia, chalk, or whitening (not carbonate or bicarbon- ate of soda)	White of egg in water or milk.
Mushrooms (and other fungi)	Yes	—	Keep patient warm
Oil of vitriol (sulphuric acid)	No	Chalk, soda or whitening	Milk, cream, olive-oil, or medicinal paraffin
Opium (Laudanum, mor- phine, etc.)	Yes	Sufficient potassium permanganate to cover a farthing, (10 grains) or 3 tablespoon- fuls Condy's fluid in 1 pint water	If possible keep patient walking about Use artificial respiration
Oxalic acid (salts of sorrel)	see	METAL POLISHES (above)	
Phosphorus	see	MATCHES (above)	
Prussic acid and cy- anide of potassium	Yes	—	Artificial respiration, alcoholic stimulants, when possible
Putrescence (bad meat)	Yes	—	Purgative Hot-water bottles to relieve pain
Spirits of salt (hydrochloric acid)	No	Chalk, bicarbonate of soda, or whitening	White of egg in water or milk, or
Strychnine	Yes	—	Artificial respiration if necessary

right angles and secure by bandages around the arm fore-arm and hand. Support the arm in a sling. For the fore-arm use two splints and a sling. For the hand a splint reaching from the middle of the fore-arm to beyond the fingers is required with a narrow fold bandage to secure it in position. This is folded in a figure-of-eight the centre part being placed over the fingers the right end carried around the outer part of the hand and the left around the thumb. These two

a splint if none other is available. When single handed or the patient is a woman the inner splint is often dispensed with. To bandage the foot apply a splint reaching from toe to heel with padding. Secure with a narrow fold bandage in a figure-of-eight thus place the centre of the bandage over the instep cross under the splint cross again behind the ankle and over the instep. Tie under the splint. Keep the foot raised. *Sling* To prevent unnecessary



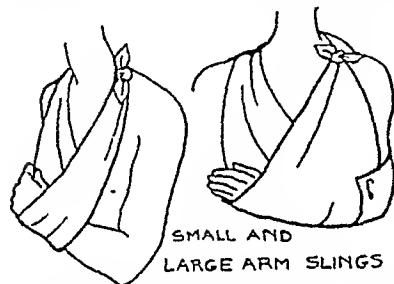
ends are crossed under the wrist and tied on top. For a broken *thigh* straighten the leg holding until it is in position. In cases of emergency bandage to the sound leg as a splint. If available a piece of wood stretching from armpit to the heel should be tied in position with possibly another on the inner side of the leg. A broken *humerus* may be treated as an elbow. In bandaging the *tibia* or *fibula* fix in n r and outer splints whilst holding the leg in its natural position. Tie above the fracture. As with the other leg as

strain on muscles and further damage to the tissues by the fractured ends of bones a broken arm is slung in a folded bandage from around the neck. A *large arm sling* is used for fractures of the fore arm and hand and a *small arm sling* made with a narrow fold bandage is used for fractures of the humerus or upper joint of the arm. A *special large triangular bandage* is used for a fractured clavicle. With one point on the sound shoulder and the middle point above the elbow of the injured arm carry the lower end over the arm under the armpit round

the back, and fasten on the sound shoulder

Sprain A sprain is recognised by swelling, severe pain, and inability to bear weight on the limb. Support the limb and apply a cold-water bandage, or lint soaked with lead and opium lotion. **Stretcher** An emergency stretcher can be made with two or three coats. Turn the sleeves inside out, button the coat, place poles down the sleeves, and tie two rods at head and foot to keep the poles apart. **Stings, Insect** The sting should be removed, and a little washing soda, blue, or ammonia applied.

Tourniquet When hæmorrhage is excessive, make a tourniquet by bandaging a pad or other hard substance over



SMALL AND
LARGE ARM SLINGS

a pressure point (see BLEEDING). The bandage is tied on the opposite side of the limb, in a half-knot, a pencil or stick is placed on this and secured in position with reef knot. Twisting the pencil applies pressure to the artery and stops bleeding.

First-aid Outfit This should contain the following requisites:

Triangular bandages, roller bandages, assorted, tincture of arnica, boracic lint, boracic lotion, carron oil, or picric acid solution, bicarbonate of soda, sal volatile, carbolic acid and lotion (1 in 40), castor-oil, medicinal paraffin, magnesia, epsom salts, potassium permanganate, brandy, lead and opium lotion, tincture of iodine, scissors, $\frac{1}{2}$ -oz measure glass, and cotton-wool.

CONSULT *First-aid to the Injured*

(St John's Ambulance Association), *Elementary Manual of First-aid* (British Red Cross Society).

First International, the International Working Men's Association, a Socialist body founded in London in 1864, very largely through the efforts of Karl Marx, to discuss and further the rights of labour. See also SOCIALISM; COMMUNISM.

First Offenders By the Probation of Offenders Act, 1907, extending the First Offenders Act, 1887, any person convicted on indictment of a first offence, instead of being sent to prison, may be released on promise of good behaviour and to come up for sentence if called upon within 3 years, if the age, character, and other circumstances of the offender are such as to warrant leniency being shown. The offender will be required to enter into a recognisance, with or without surties, and may be ordered to pay the costs of the proceedings and compensation for damage done.

Fischer, Emil (1852-1910), German chemist, an authority on organic chemistry. He held professorships at Erlangen, Würzburg and Berlin (1892), received the Royal Society's Davy medal (1890), and was awarded the Nobel chemistry prize in 1902. His works include accounts of his discoveries in connection with indigo, carbohydrates, dyestuffs, uric acid, enzymes, and the purine group of uric-acid compounds, and the chemistry of proteins.

Fish, cooking of. The best methods of cooking fish are:

Bass, stuff and bake, bloaters, grill, bream, stuff and bake, or grill, brill, fry in slices, which have been skinned and boned, garnish with potatoes and mushrooms, carp, stuff and bake, charr, fry in egg and breadcrumbs, or grill, chub, bake in casserole with herbs and flavourings and thicken the liquid; cockles, steam until the shells open, pickle in spiced vinegar, serve in sauce, cod steam, fry, or fry in batter, cod roe, fry in egg and breadcrumbs, or boil

with salt and vinegar in water serving with sauce on toast conger eel bake and stuff or stew crawfish as with butter crayfish boil or use as a soup ingredient dab fry in egg and breadcrumbs or steam dace fry or steam fry in egg and breadcrumbs or stew with herbs and other flavourings jelly in flavoured stock flounder fry steam or bake in fillets gurnet and haddock steam fry plain or in batter or stuff and bake hake bake cutlets with breadcrumbs herring roll with skin scored diagonally fry in egg breadcrumbs or with oatmeal upper grill or bake ling steam fry plain or in batter or bake loach steam mackerel grill, fry in egg and breadcrumbs bake with diagonally scored skin or boil with herbs and sliced vinegar in water pike remove head and boil as with mackerel plaice steam in spiced milk or stuff and bake ray *see* skate roach boil in water flavoured with herbs horse-radish and vinegar or fry in seasoned flour serving with sage sturgeon fry cutlets in egg and breadcrumbs or stuff and roast shad grill or steam in white wine skate boil in water and vinegar serving with beurre noir (*q.v.*) or cut along the sides into narrow strips and soak in cold water before broiling smelts dip in flour egg and breadcrumbs flour again and fry in oil flour or dip in egg and breadcrumbs and fry or bake with flavourings or bake and coat with a cheese sauce or stuff and bake whitebait coat with flour and fry whiting fry in egg and breadcrumbs

Fisher Andrew (1869-1929) Australian politician. He emigrated from Scotland. In 1893 he entered the Queensland Parliament and the Commonwealth Parliament in 1900. He was Minister of Customs in Watson's Labour Cabinet. Labour Party leader and between 1908 and 1915 was three times Prime Minister. He was High Commissioner in London 1916-21.

Fisher Herbert Albert Laurens (b 1860) British historian and politician was Lecturer in Modern History at

Oxford 1911-19 entered Parliament in 1916 and became Minister of Education under Lloyd George introducing many reforms. He has served on State commissions and was a British delegate to the League of Nations 1920-2.

Fisher John (c 1492-1535) Cardinal bishop of Rochester and English R.C. martyr. After studying and later teaching at Cambridge he was consecrated bishop in 1504. Always independent he did not hesitate to condemn clerical display and greed even to Wolsey's face he opposed the divorce of Henry VIII and Catherine of Aragon. On his refusal to take the oath to the king in the Act of Succession he was imprisoned. He was deprived of his see after the passing of the Act of Supremacy and beheaded for treason in 1535 for refusing to acknowledge the king as head of the church. He was beatified by the Catholic Church in 1896.

Fisher John Arbuthnot, 1st Baron (1841-1900) British admiral. As a gunnery expert he commanded the *Inflexible* at the bombardment of Alexandria 1882 and was later in command on various stations of the British Navy. He became Second Sea Lord in 1902 and was First Sea Lord 1904-10 and 1914-15. By his drastic reforms in organising crews and sponsoring oil burning dreadnoughts the Navy was ready for the World War which he had foreseen. He initiated the blockade and dispatch of Sturdee to engage Von Spee at the Falkland Islands Dec 1914. Fisher favoured a combined naval and military attack on the Prussian coast. He resigned in 1915 over the failure of the Dardanelles expedition, which he had opposed. He later served on the Board of Invention and Research. Fisher published *his Memories and Records* in 1919.

Fishes, a class of cold blooded aquatic gill breathing vertebrate animals absolutely distinguished from the other classes the Amphibia Reptiles Birds and Mammals by having the two pairs of appendages fin like,

and never divided into the three definite parts of a typical vertebrate limb, in which the terminal part primarily is a five-toed foot. Fishes also have unpaired dorsal and ventral fins supported by rays developed from the skin. This definition applies to all the typical fishes, but not in every respect to the lampreys and hag-fishes (*qq v*), which are popularly regarded as fishes, but are now considered by most zoologists as forming a class by themselves called the *Cyclostomata*.

Fishes, with a few exceptions (*see* LUNG FISHES and CLIMBING PERCH), are unable to live long out of water. Some, like pikes and carp, are found only in fresh waters, others only in the sea, from the surface to a depth of nearly 3000 fathoms. A few, like the salmon (*q v*), migrate from the sea to fresh water to breed, whereas the eel (*q v*) descends from the rivers to the sea for that purpose. Most of them lay eggs which are fertilised after deposition and may number millions, as, for example, in the cod. In some, like the sharks, the eggs are fertilised internally, and the young are developed for 7 or more months within the mother before being laid in a large leathery egg-case. A few sharks and rays are even viviparous, and in these cases the young are few in number. The eggs and young are usually left to their fate, but in one or two cases, *e g* the sea horse and the stickleback (*qq v*) the male looks after the brood.

No class of the Animal kingdom surpasses the fishes for brilliance and variety of colour and pattern. By the contraction and expansion of the coloured areas or chromatophores under the incidence of light acting through the eyes on the nervous system, many fishes, like the stickleback and flounder (*qq v*), can change their colours, often with great rapidity, to harmonise with that of their surroundings. Even in the most strikingly tinted species the colouring usually makes for concealment, either for eluding enemies or capturing prey,

but in some species, like the file-fish (*q v*), and others armed with sharp or poisonous spines, the bright colours may serve the purpose of advertisement. Deep-sea fishes are generally uniformly black or brown, and possess phosphorescent organs of various kinds, partly to illuminate the darkness of the depths in which they live, and partly, in those species in which they are developed at the end of long antenniform processes on the head, to act as a lure for prey.

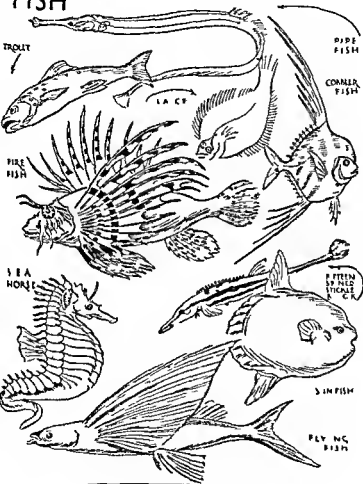
These luminous organs must not be confused with the electric organs, which are batteries for giving shocks either for defence against enemies or for killing prey. The most familiar species provided with these organs are the electric eels, the electric ray or torpedo (*see* RAY) and a species of African catfish (*q v*).

Since fishes have no true lungs, it might reasonably be supposed that they are voiceless. But a great many fishes are known to be able to emit sounds which are produced apparently by the contraction of the air-bladder. The voice of eels and some carps, for instance, results from the expulsion of air from that organ. Many fishes also possess so-called stridulatory organs, so common in the Arthropods, which give out a variety of sounds by the friction or knocking together of hard parts of the outer skeleton, or sometimes by grating the teeth, as in the sunfish (*q v*).

Fishes feed almost exclusively upon other water animals, which they usually catch in open water or find amongst the rocks, sand, or mud, or secure by lying quietly in wait at the bottom. Most of the last category, like the flat-fishes (*q v*), are poor swimmers, flapping along slowly through the water, but the more actively predatory fish are rapid swimmers, propelling themselves by vigorous side strokes of the tail, the fins of the body being used mainly as balancers to prevent rolling over in the water.

The true fishes (class Pisces) are

FISH



usually divided into three subclasses, although some writers admit a fourth

The first subclass is the *Elasmo-branchii*, distinguished by their scales and cartilaginous skeleton without accessory "membrane" bones. Also the eggs are fertilised and the young developed for a long time internally. To this group belong the sharks, dog-fishes, skates, and rays, which have the gill clefts exposed as slits and a cloaca (*q v*), and a peculiar deep-water fish called *Chimaera*, which differs from the preceding forms by having the gill-slits covered and no cloaca.

The second subclass, called *Teleostomi*, is distinguished by its rhomboid or rounded scales and the presence of accessory membrane bones on the skull, jaws, and pectoral arch, and by the external fertilisation of numerous eggs. This subclass contains nearly all the common so-called bony fishes, but some of its members, like the sturgeon and N American garfish (*qq v*) and other fresh-water species from America and Africa, are in some respects intermediate between the shark group and typical fishes, and they are sometimes separated as a subclass called *Ganoides*, because of the prevalent nature of their scales (see *GANOID*). The typical and familiar bony fishes, called *Teleostei*, are divided into a great many subordinate groups, of which the best known are mostly referable to two groups called the "soft-finned," containing the salmon, herring, etc., and the "spiny-finned," containing the perch, mackerel, etc.

The third subclass, called *Dipnoi*, or *Dipneusta*, comprises the lung-fishes (*q v*), and serves in a measure to connect some of the so-called Ganoid fishes with the Amphibia. The air-bladder is capable of acting as a lung, and the nasal passages open into the mouth. The paired fins are unique in having a central jointed axis to which the rays are attached, and it is possible to see in these fins a foreshadowing of the five-toed foot of the Amphibia,

of which some extinct form of lung-fish was no doubt the ancestor.

See Norman, J R, *A History of Fishes* (Benn, 1931), Boulenger, G A and Bridge, I W., "Fishes," *Camb Nat. Hist.*, vol vii (1910), Goodrich, E S, "Cyclostomes and Fishes," Part IX of *A Treatise on Zoology* (Black, 1909).

Fishguard (*Abergwain*), Welsh port on the N coast of Pembrokeshire, with a good harbour, starting-point of GWR passenger boat service to Rosslare, Ireland. There is a local fishing industry. Pop (1931) 2063.

Fishing, see *ANGLING*, *TRAWLING*.

Fish Kettle, a large, oval-shaped saucepan, usually fitted with a perforated tray with handles, used for lifting the fish out. An oval steamer can be fitted over this.

Fitch (or *Fitchet*), another name for the polecat (*q v*).

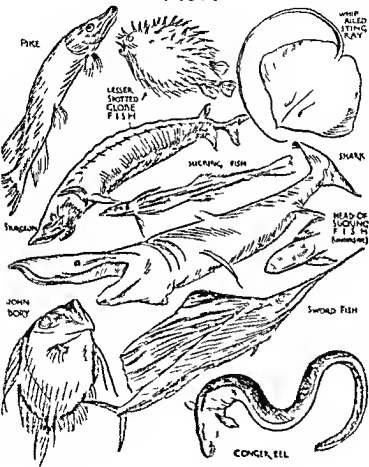
Fitton, Mary (*fl c* 1600), is thought by some to have been the "dark lady" of the sonnets of Shakespeare. She is known to have been one of Queen Elizabeth's maids-of-honour, but there is little foundation for her identification with the "dark lady."

Fitzgerald, Lord Edward (1763-1798), Irish soldier and patriot. He served in America, explored part of Canada (1789), and returned to enter the Irish Parliament, joining the United Irishmen in 1798. Two years later he conspired with the French for a rising in Dublin, was betrayed by his colleagues, and wounded during his arrest. He died in Newgate.

Fitzgerald, Edward (1809-1883), English poet, translated *The Rubáiyát of Omar Khayyám* (1859), and other works. The style and spirit of the famous version are close to those of the original, and the rhythm and melody of the verse have given it a wide popularity.

Fitzherbert, Maria Anne (1758-1837), the secret wife of George IV, as Prince of Wales. The marriage in 1785 was not recognised as valid, but was resumed on George's separation

FISH



from Princess Caroline, ending finally in 1803

Fitzmaurice, Sir Maurice (1861-1924), British engineer. He graduated from Trinity College, Dublin, and was chief engineer of the London County Council 1901-12. He built the Rotherhithe tunnel under the Thames (1908), and a tram subway under Kingsway, connecting N and S London tramway systems.

Fitzmaurice-Kelly, James (1858-1923), writer on Spanish literature. He was lecturer in Spanish at Oxford and Cambridge, professor at Liverpool (1909-16), and London University (1916-20). He wrote *Life of Cervantes* (1892), *History of Spanish Literature* (1898), and edited the *Oxford Book of Spanish Verse* (1913), and the *Works of Cervantes*.

Fitzroy, Robert (1805-1865), British sailor, hydrographer, and meteorologist. As commander of the *Beagle* he surveyed the coasts of Patagonia and Tierra del Fuego, 1828-30, and on a second voyage in 1831-6, when he was accompanied by Charles Darwin. He also surveyed the Chilean coast. He was Governor of New Zealand 1843-5, and later meteorologist to the Board of Trade. His *Weather Book*, 1863, forms the basis of modern meteorological forecasts.

Fitzsimmons, Robert (1862-1918), English boxer, born at Helston, Cornwall, was the last Englishman to hold the World's Heavyweight Championship, which he won in 1897 by knocking out J. J. Corbett (*qv*) with a "solar-plexus" punch. He lost the title to Jim Jeffries (*qv*) in 1899.

Fitzwalter, Robert (d. 1235), leader of the barons against King John of England. He was exiled for his rebellion in 1212, but returned to head the movement which resulted in John's signing Magna Carta, 1215. He later supported Prince Louis of France in his invasion of England, 1216-17.

Fitzwilliam Museum, contains a collection bequeathed by Viscount Fitzwilliam in 1816 to the University of

Cambridge. The collection, which includes paintings, sculpture, books, etc., was considerably increased by the Marlay bequest of 1912.

Fiume, Italian port on the Adriatic, at the head of the Gulf of Fiume, an export centre for sugar, petrol, and rice. It has been in the possession of a number of Powers, including Austria and Hungary, attaining in 1919 a grave political significance. It was claimed by Italy, since the majority of its inhabitants had long been Italian, but the new State of Yugoslavia claimed equal rights to it, as Hungarian territory. Yugoslav forces occupied the town, the Italian fleet the harbour. In the meantime D'Annunzio, with an irregular force, invested Fiume, and declared the foundation of the territory of Carnaro. This put the whole matter in a diplomatic impasse, from which the Italians extricated themselves by driving out D'Annunzio and attempting to establish a joint friendly occupation with the Yugoslavs. Two years later the Fascist *coup d'état* made it Italian, and in 1921 Signor Mussolini negotiated a treaty whereby Italy held the town, and Yugoslavia the neighbouring river delta and the town of Porto Baross. Later still a free zone around Fiume was established. Pop. 106,800.

Five Mile Act, The, statute of 1592, repealed in 1844 after long disuse, forbidding popish recusants convicted of not going to church, from moving above 5 m. from their usual place of abode. Also a statute of 1665 forbidding clergymen who refused to take the oath of non-resistance, imposed by the Act on all who had not subscribed to the Act of Uniformity, from coming within 5 m. of a corporate town.

Five-Year Plan, a project of national development, principally in the industrial sphere, but also in agriculture, education, etc., embarked upon in the USSR in 1928. After the revolution and the internal struggles of 1918-21, the economic structure of Russia appeared on the point of collapse. Factories, deprived of technical

parts and the means of repair broke down the peasants lacking incentive refused to produce food for the towns despite the extreme and sometimes excessive pressure that was brought to bear on them. In 1923 Lenin introduced the New Economic Policy which allowed a certain freedom of individual trading in order to prepare the way more gradually for a Communist economic régime. While production returned to more normal levels Lenin and his successors after his death were working out a plan of intensive industrial and agricultural development based primarily on widespread electrification. The object of this plan was to make Russia entirely independent of outside sources of supply to make the State independent of individual traders and producers and to raise the general standard of living by an intensive process of industrialisation. The system of control figures on which the administration of the Plan was based had already been in force since 1915, thus consisted in an estimate of future production in each field and a continual comparison between this estimate and achieved results. By 1928 conditions were sufficiently favourable to set the plan in action. A State Economic Planning Commission (the Gosplan) was formed from a meeting of economic experts and was made responsible for the execution of the Plan receiving its orders direct from the Council of Labour and Defence.

The Five-Year Plan (or *pyatiletki*) was begun in the autumn of 1928 and its completion was planned for 1933. In that time the national income was to be doubled and the capital invested in industry to be trebled. Total production was to be increased by 181 per cent. In heavy industries by 255 per cent and in agriculture by 151 per cent, largely by the widespread introduction of mechanical power and a 253 per cent increase in the output of electricity. Twenty-five per cent more workers were to be brought into manufacturing industry enormous

factories and plant were to be built in various parts of Russia and the rail ways were to be developed to carry the enormous burden of new trade.

Each industry or field of production was in the hands of a national combination which administered a series of Trusts linking factories manufacturing a similar product. The basic idea of the first Five Year Plan was to lay the foundations of an industrial system and to concentrate all the national energies on increasing capital plant and the capacity for future production. This entailed a development of heavy industries mines oil wells and transport at the expense of finished consumers goods which were sacrificed for a future rise in the standard of living. All the national savings were reinvested.

Among the most important individual works undertaken were those relating to coal and steel to automobiles to water power and to tractors. A huge steel plant was built at Magnitogorsk in the Urals and another in the Kuznetsk Basin in Siberia a special road being constructed to carry coal from a field in the latter to the former. The largest dam and hydro-electric power plant in the world was planned at Dnieperstroï and opened in 1933. A factory with an output of 140 000 cars and trucks a year was built at Nijni Novgorod. To hasten agriculture plant with a capacity of 50 000 tractors a year was planned for Stalin grad on the Volga similar factories were allotted to Cheliabinsk and Kharkov while one devoted especially to agricultural machinery was built at Rostov.

Besides a great increase in agricultural production a revolution in the organisation of rural districts was also planned. In 1927-28 93 per cent of the total farmed area was worked by individual peasants. The whole food supply of the towns and indirectly the complete economic system was therefore in the hands of the peasants who betrayed small sympathy with the Government and over whose produc-

tion there was no control. Under the Plan this situation was to be changed by bringing 14.3 per cent of the area into collective farms and 3.5 per cent into State farms, the output of which would render the State independent of individual peasants. Two vast State farms were developed in the N Caucasus Region, the Gigant and the Verblud, the former of which in 1931 ploughed an area of nearly 500,000 acres, and raised over 1 million tons of grain. These were staffed by specially selected workers, for whom towns were built.

Seven thousand m. of new railway were to be constructed, the most important section of which was the Turkish, a line planned to join the Iran-Siberian Railway with the E terminus of the Moscow-Tashkent line, thus opening up the huge cotton regions of Turkistan and the Steppes of Kazakhstan and allowing an interchange of Siberian timber and grain with Central Asian cotton. Turkish was opened in 1930.

Many difficulties were encountered. There was an almost complete lack of technical experts to supervise the construction and installation of plant. Engineers and technicians and other plant workers were attracted from the United States, and lesser quantities from the United Kingdom and Germany. With these came every thou-

sands of foreign experts to teach the Russians their management. In order to pay for these imports, Russia had to raise foreign credits, and was forced into the wholesale export of wheat, oil, and other bulk commodities at whatever price they would fetch. With the fall of international prices in 1930-3 difficulties were encountered in getting sufficient credits, and still larger amounts had to be exported to raise the same sums. This export caused a considerable scarcity at home.

A further difficulty was the inefficiency of the Russian workmen, who were unaccustomed to handling machinery. Even with the establishment of highly mechanized factories, output per man remained very low, the quality of goods produced was unsatisfactory, and there was a very high rate of breakages and breakdowns, plant often remaining inactive for lack of repair facilities.

These setbacks were combated by intensive technical training, by "Stakhanov competitions" organized between factories and departments, by "shock brigades" of workers who voluntarily undertook to exceed normal output, by the acceleration of inefficient plants by extra efforts, and by other means. Coming out on the trend of the first 2 years of the Plan it was decided to complete the Five-

TABLE 1. — FIVE-YEAR PLAN FOR THE FIVE YEAR PERIOD 1926-1931

	1926-1927	1927-1928	1928-1929	1929-1930	1930-1931
Grain	100	100	100	100	100
Wheat	100	100	100	100	100
Barley	100	100	100	100	100
Oats	100	100	100	100	100
Rye	100	100	100	100	100
Flax	100	100	100	100	100
Cotton	100	100	100	100	100
Wool	100	100	100	100	100
Iron	100	100	100	100	100
Steel	100	100	100	100	100
Coal	100	100	100	100	100
Oil	100	100	100	100	100
Electricity	100	100	100	100	100
Transport	100	100	100	100	100
Construction	100	100	100	100	100
Education	100	100	100	100	100
Health	100	100	100	100	100
Science	100	100	100	100	100
Arts	100	100	100	100	100
Industry	100	100	100	100	100
Commerce	100	100	100	100	100
Finance	100	100	100	100	100
Law	100	100	100	100	100
Religion	100	100	100	100	100
Philosophy	100	100	100	100	100
History	100	100	100	100	100
Geography	100	100	100	100	100
Mathematics	100	100	100	100	100
Physics	100	100	100	100	100
Chemistry	100	100	100	100	100
Biology	100	100	100	100	100
Medicine	100	100	100	100	100
Psychology	100	100	100	100	100
Sociology	100	100	100	100	100
Political Science	100	100	100	100	100
Economics	100	100	100	100	100
Statistics	100	100	100	100	100
Accounting	100	100	100	100	100
Law	100	100	100	100	100
Religion	100	100	100	100	100
Philosophy	100	100	100	100	100
History	100	100	100	100	100
Geography	100	100	100	100	100
Mathematics	100	100	100	100	100
Physics	100	100	100	100	100
Chemistry	100	100	100	100	100
Biology	100	100	100	100	100
Medicine	100	100	100	100	100
Psychology	100	100	100	100	100
Sociology	100	100	100	100	100
Political Science	100	100	100	100	100
Economics	100	100	100	100	100
Statistics	100	100	100	100	100
Accounting	100	100	100	100	100

Egyptian, Assyrian, and Persian armies. The Romans had a special standard for each century or hundred men, usually with an animal figure, the eagle finally emerging as the national emblem. Religious flags, usually decorated with crosses of various shapes and colours (e.g. the St George's Cross and the Dannebrog), were used between the 10th and 13th cents. Pennons, bearing birds and animals as distinguishing marks, were flown from the tips of lances at the battle of Hastings (1066), and were probably the forerunners of heraldic distinctions. In the 12th cent banners dedicated to the saints were borne in battle, but in the 14th cent there was an increasing use of heraldic pennons, banners, banderoles, streamers, etc., which bore their owners' coats of arms. The banner, roughly square in shape, was borne by knights banneret and higher ranks, and served as a rallying-point in battle. The standard was of larger size, fringed and tapering, and was used chiefly on ceremonial occasions.

The royal standard of England gradually came to be associated with the nation as a whole. The three lions passant guardant adopted by Richard I were quartered with the lilies of France by Edward III, and led the English army in battle. James I introduced the Scottish lion rampant and the Irish harp, William III superimposed an escutcheon of Nassau, and George I added that of the electors of Hanover. At the accession of Queen Victoria the royal standard assumed its present form. The Union Jack, incorporating the crosses of St George, St Andrew (1707), and St Patrick (1801), became the national flag, while various ensigns (*qv*) incorporating the Union Jack were used for specific naval and maritime occasions. Two other important British flags are those of the Admiralty (a yellow anchor on a red field) and of Trinity House (white field with a red cross and an ancient ship riding waves in each quarter).

In the United States, the flags of the

individual colonies were superseded by the Grand Union (red and white striped with a Union Jack in the dexter chief) in 1773. On the Declaration of Independence (1776) the Union Jack was replaced by a constellation of 13 stars, representing the 13 States, and the familiar "Stars and Stripes" was evolved. There are now 48 stars, in 6 rows of 8 each.

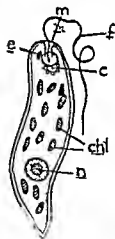
Various national flags were developed between the 15th and 20th cents, the latest addition, that of Soviet Russia (1929), being a golden sickle crossed with a golden hammer, superimposed by a golden star in the top right-hand corner of a red field.

In the Navy flags are made in multiples of 9-in bunting widths, the largest ensign being 33 x 16½ ft. Signalling flags are used in recognised codes (*qv*), but certain colours have recognised international significations—red for mutiny, black for piracy, yellow for infectious disease, and white for truce. At sea, one ship salutes another by dipping its flag, while "striking" flag is a signal of surrender.

Flagellants, those who scourge themselves for religious purposes. This practice is found in many religions, but it is best known from the flagellations of the mediæval friars, such as the Franciscans, who used it as a penance. Several flagellating orders of later origin were suppressed for heresy in the 15th cent and it is to such that the term is usually applied.

Flagellata (or *Mastigophora*), an important class of the Protozoa (*qv*). Like the Ciliata, they have a definite shape, but are without cilia, and progress by means of one or more lash-like flagella (*see* FLAGELLUM). Most of the Flagellata are found in organic matter, in salt or, more usually, in fresh water, but are not putrefactive agents. Many of them, however, known collectively as hæmatozoa, are blood parasites, the most important being the trypanosome, which causes sleeping sickness (*qv*). One or two nuclei and a contractile vacuole are characteristic, and a mouth is often

present Nutrition is effected either by the holozoic holophytic, or saprophytic method (see DIETETIC SYSTEM) Reproduction may be effected in the active stage by fission or in the resting stage by the breaking up of the cell contents into swarm-spores or zoospores which may conjugate The general shape may be spherical oval or elongated and the base of the flagellum may be encircled by a collar Most forms are solitary but some are colonial Like the rest of the Protozoa the Flagellata are too microscopical to be well known and hence have received no popular names and it is only possible to mention a few which by their colouring matter or other characters have attracted popular attention *Hamatoroccus* the organism which reddens snow in the Arctic regions is oval with a pair of flagella One of the largest of the Flagellata *Euglena* some times so abundant in fresh water as to give it a green tinge is elongated has a single flagellum rising from the mouth a contractile vacuule a nucleus a pigment spot sensitive to light and numerous particles containing chlorophyll oil and starch An other green freshwater representative is *Volvox* a colonial form composed of a spherical mass of thousands of cells collectively as large as a pin's head



Euglena, typical member of the Flagellata.
c. Contractile vacuule.
chl. Chloroplasts.
n. Nucleus.
f. Flagellum.
m. Mouth.

most of the cells having a pair of flagella The most familiar marine form is *Noctiluca* a comparatively large peach shaped animalcule with two flagella It is the cause of the phosphorescence of the sea in temperate latitudes

Flagellum, a long lash like protoplasmic appendage the organ of locomotion in the Protozoa (q.v.) of the class Flagellata and in the male reproductive cells of most animals

Flageolet, an old musical wind instrument whose modern descendant is the humble tin whistle constructed on the same principle Its tone was mellow but less piercing than that of the piccolo

Flamborough Head, a cape in Yorkshire England 18 m S.E. of Scarborough A lighthouse on the head



Flamborough Head S.E. of Scarborough can be seen 25 m. to sea. There is an old British earthwork near by known as Dane's Dyke

Flamboyant Style (architecture) the last phase of French Gothic (see ARCHITECTURE) The style which is an adaptation of English Decorated (q.v.) flourished in the 15th cent It is characterised by reversed (ogee) curves in the window tracery producing a flame like (flamboyant) effect and by great elaboration of ornament Examples St Maclou Rouen W. façade a Rouen Cathedral and St Wulfram Abbeville The excessive use of ornament has led to a secondary meaning of flamboyant in the sense of highly coloured florid over conspicuous

Flame-thrower, a weapon first used by the Germans in 1914-15, and later adopted by the French and British, consisting of a chamber of air or nitrogen under high pressure, and a container filled with a mixture of heavy and light oils, the latter fired by the release of the former. There were two types, a heavy model with a range of 130 yds., and a portable one with a range of 45 yds. *See also* CHEMICAL WARFARE.

Flamingo, a web-footed bird with very long legs and neck and a short bent beak which, except for its shape, resembles that of a duck, and is used for sweeping and sifting food from the surface of water. The flamingoes are in many ways a connecting link between the duck and heron tribes. They are mainly white, pink, or scarlet, according to the species, and frequent salt lakes in vast flocks, where they feed and breed, making their nests of mud, and sitting on their eggs in the usual way with the legs tucked up, the old belief that the nest was shaped like a chimney-pot and that the flamingo stood astride it during incubation being unsubstantiated.

Flammenwerfer, *see* FLAME-THROWER, CHEMICAL WARFARE.

Flamsteed, John (1646-1719), English astronomer. Though trained for the Church and appointed to a living at Burstow, he preferred to study the stars. He was the first modern to understand the theory of the equation of time, on which he published a paper in 1667. About 1674 he went to London, where he associated with Hook, Halley, and Newton (*qv*). In 1675 Charles II appointed him the first Astronomer Royal, and empowered him to build an observatory at Greenwich, in which he determined the position of 2884 stars.

In 1725 the results of his life's work were published under the title *Celestial History*, one of the richest contributions to practical astronomy.

Flan, *see* PASTRY, SWEET.

Flanders (Flem. *Vlaenderen*, Ger. *Flandern*), comprises the modern prov-

inces of E and W Flanders, in N and N W Belgium. From about the 7th to the 16th cent it was an independent kingdom and occupied the W. of modern Belgium, S W Holland, and part of N W France. Parts of W Flanders have been successfully drained and agriculture flourishes, and the coast fisheries are valuable. There are a number of large industrial towns: Ghent, Bruges, Alost, Dixmude, Courtrai, Ostend, and Zeebrugge, with manufactures of textiles, lace, paper, and engineering works.

History—Flanders was originally occupied by the Celts, who were conquered by the Romans, and formed part of Roman Gaul, later it was overrun by the Franks, many of whom settled here. By the 10th cent it was a powerful kingdom. Commerce and industry were encouraged and many of the now important towns were founded at this period. Owing to breaks in the direct line of succession, Flanders was ruled at various times by princes from other States. The country passed to France, partly through marriage, and partly by conquest, and an era of keen competition between the great cities of Ghent and Bruges set in. By the middle of the 14th cent Flanders passed to Burgundy by a marriage between the French royal family and the Burgundians, and its existence as a separate State ceased, the princes subdued the large towns, and exacted great revenues, ruthlessly suppressing all attempts at Flemish independence. After the Burgundians, the Habsburgs continued the same policy. The War of Dutch Independence impoverished and reduced the size of the country, which was ultimately split up between France, the Spanish Netherlands, and the United Provinces.

Napoleon incorporated the whole of the Belgian portion into France, dividing it into the present districts of E and W Flanders. After the Congress of Vienna Flanders formed part of the kingdom of Belgium, since when it has

retained its name in the two Belgian provinces

There is a strong movement among the Flemings for local autonomy and during the World War an attempt was made by Germany to set up an independent Flanders

Area of modern provinces E Flanders 1150 sq m W Flanders 1900 sq m pop (1931) E Flanders 1 150 000 W Flanders 902 000

Flannel, *see* TEXTILES

Flash Point, of an inflammable liquid that temperature at which if a flame is momentarily passed over the surface the vapour will take fire The determination of the flash point is extremely important since it gives the degree of inflammability of a liquid and is a measure of its safety in transport and handling In this country the usual method of determining flash point is by the Abel apparatus the form of test prescribed by the Petroleum Act of 1879 The apparatus is of the closed-cup type and the oil in it is heated gradually till on applying a light at the orifice of the cup a flash occurs The limit of flash point under the Petroleum Act is 73 °F Liquids having a flash point below this are subject to special regulations with regard to transport and storage

There are several other varieties of flash point apparatus both of the closed cup and open-cup types

Flatbush *see* BROOKLYN

Flat-fish, strictly speaking marine fishes like the sole plaice turbot and other bony fishes which habitually lie on the sandy bottom of the sea resting on the right or left side both the eyes being on the side of the head which looks upwards The name however is sometimes given to the skates and rays which have the same bottom frequenting habit and are also flattened but these rest on the lower surface of the body with the back uppermost and the two eyes on the top of the head

Flat formity of the foot in which the whole extent of the sole is in contact with

the ground It seldom occurs in active people but is commonest in young persons of poor physique who are obliged to stand for long periods or carry heavy burdens The ligaments are still soft and too much work is thrown on the muscles which give way The symptoms are severe pain in the sole a shuffling gait and fatigue after a little exercise It may give rise to compensating curvature in the pelvis or spine In early cases the patient should rest take up a sedentary occupation and take special exercises to strengthen the weak part Bathing with cold salt water is useful In more severe cases artificial support from a pad or steel sole inside the boot may be required or the foot may be set in plaster of paris or even operated on

Flatulence *see* BOWELS DIGESTIVE SYSTEM

Flatworms (or *Platyhelminthes*) a lowly organised phylum of worm like mostly endoparasitic creatures distinguished by the incomplete development of a definite cavity of the body in the mesoderm or middle layer of cells by the fact that the alimentary canal when present has no posterior outlet and by the absence of circulatory and special respiratory systems A nervous excretory and reproductive system is present the last being hermaphrodite

There are three classes of flatworms the flukes (qv) or trematoda the tape worms (qv) or cestoda and the planarian worms or turbellaria The planarian worms are on the whole the most highly organised being mainly free living and found in the sea fresh water or damp situations on land They are unsegmented covered with cilia and vary greatly in size and shape being flattened and leaf like or narrow and worm like some reaching a length of several in. although most are much smaller Some of the larger land forms feed on earth worms Planarians are classified by the structure of the alimentary canal, which is sometimes absent but when present

may be simple or extensively branched

The trematode flat worms are parasitic, unsegmented, and without cilia, but provided with suckers and an alimentary canal. They are worm-like or leaf-like in shape. Some are parasitic on a single host, and develop direct without intervening sexless forms, others parasitise two hosts in their life-history, and pass through an alternation of generations (see FLUKE).

The cestodes are parasitic, have no cilia, are usually provided with adhesive suckers or hooks, but have lost all trace of the alimentary canal. The body is usually very long, owing to its division into a large number of reproductive segments (see TAPE-WORM).

Flaubert, Gustave (1821-1880), French novelist, published his first novel *Madame Bovary* in 1857. It took 4 years to write *Salammbo* (1862) tells of the Punic Wars, *L'Education Sentimentale* (1869) and *Trois Contes* (1877) complete the list of his best-known works. They are notable for the clarity of their style and for Flaubert's intense loathing of the *bourgeois*. The former was only attained after an immense amount of labour, Flaubert wrote and re-wrote his sentences, polished and re-polished his phrases, until he achieved perfection. It was to Flaubert's influence that de Maupassant owed the clarity of his style.

Flax, a slender plant, of the natural order Linaceæ, with erect stem, narrow leaves, and sky-blue petals which fall when touched. There are 2 varieties, *fine flax* grown for linen manufacture and *mixed flax*, sown in May on rich fertile land, usually after a corn or potato crop. After the June flowering the plants may be harvested for fibre, usually pulled by hand, but sometimes cut by machine like a cereal crop. For seed, the straw is steeped in soft water to rot the vegetable matter of the fibre which is then dried and "seutched" or dressed by beating and used for paper-making, while from the seeds is expressed linseed oil, the remainder forms "oil-

cake" for cattle food. See also CELLULOSE.

New Zealand flax (*Phormium tenax*) is a perennial herbaceous plant of the order Liliaceæ. It grows to a height of 6 ft., and bears yellowish-red tubular flowers c. 2 in. in length. The leaves spring direct from the root, and are tough, leathery, and sword-shaped, and several feet in length, their fibre is woven into mats and ropes. It is native to New Zealand, but will grow in Britain. In New Zealand it is selectively bred to increase its productivity and strength, and the fibres are sometimes extracted by a process of separation by hand. In England, where it is used for making ropes and sails, the leaves are softened by maceration before extraction of the fibre.

Flaxman, John (1755-1820), English draughtsman, designer, and sculptor, was born at York. From 1775 he worked for 12 years as a designer to the pottery firm of Wedgwood, and began to carve monuments for tombs and memorial reliefs, of which a number exist in the English cathedrals and churches. In 1787 he went to Rome, where he remained for 7 years, and there began to produce those silhouette illustrations of classical literature—after the manner of Etruscan vases—which gained him so much fame.

In 1800 he became an R.A., and 10 years later Professor of Sculpture at the Royal Academy. He continued to produce numerous monuments and further classical illustrations, of which some were engraved by William Blake. His sculpture is not greatly admired to-day, as it is somewhat pseudo-heroic or pseudo-classical in nature. Both Westminster Abbey and St Paul's contain several examples. Even his reliefs, which are far more successful, are marred by having been cut by workmen, and are greatly inferior to the original plaster casts from which they were made. Both the British and the Victoria and Albert Museums have specimens of his drawings and sketches.

Flax-seed Oil more commonly known as linseed oil (qv)

Fleas are small wingless insects parasitic when adult on warm blooded animals. They are assigned to the order Aphaniptera the affinities of which are not known. The jaws of the adults are modified for piercing the skin and sucking the blood of the host the body is flattened sideways so as to pass readily between the hairs or feathers and the legs are large and adapted for hopping. About 500 species are known some restricted to particular hosts but most of them living indifferently on hosts of distinct kinds. The metamorphosis is complete. The eggs laid on the host fall to the ground and hatch into legless grubs which feed upon any organic matter or dirt on the floor. When full sized they pupate the complete development from egg to adult taking usually c 1 month. On emerging from the pupa the mature flea seeks a host but is able to live a considerable time even if unable to find one. If the host dies they leave the body and adopt the first warm blooded animal they come across.

The best known species are those found in human dwellings infesting man dogs cats rat and mice but rabbits squirrels fowls and other animals also harbour them. Formerly fleas were merely regarded as pests owing to the irritation caused by their bites but it is now known that they are a serious menace as transmitters of bubonic plague principally from rats to human beings. About a dozen species are capable of conveying the infection.

A curious modification of the ordinary life-history of fleas is shown by the tropical pest called the *tyger* or *chigoe*. This flea affects a great many hosts usually attacking the feet. The female burrows under the skin mostly of the toes of man and swells to the size of a pea. Fortunately it is easily extracted by excising the skin.

So-called performing fleas are fastened to light objects which in

their efforts to escape they pull along. The performance is a high tribute to skilful manipulation by the owner not to the docility of the fleas which are incapable of being trained.

Flecker James Elroy (1884-1915) poet and dramatist studied Oriental languages at Cambridge. He entered the diplomatic service and was stationed in Constantinople and Beirut (1910-13). He died of consumption at Davos. His works include *The Golden Journey to Samarkand* (1913), *Hassan* (staged in London 1913) and *Don Juan* as well as many lyrics of great beauty. *Hassan* in which his ability is perhaps best seen is rich in language and thought and is the most popular of modern poetic dramas.

Fleet, a body of ships especially ships of war under a single command. In the British Navy the large area commands are called fleets e.g. the Mediterranean Fleet composed of a number of squadrons of battleships, cruisers etc. and several flotillas of destroyers and submarines. The word is also used of a number of fishing vessels or of the total of merchant or passenger ships controlled by a single company and of road and air chutes.

Fleet Prison a famous London prison which stood in Farringdon Street on what was called Fleet Market from the R Fleet which flowed into the Thames. Its keeper was called the Warden of the Fleet. As far back as the 17th cent. the Fleet served as a royal prison. In the reigns of Mary and Elizabeth it was owed for famous martyrs and the political victims of the Star Chamber. In 1641 it became a place of confinement for debtors and persons committed for contempt of court, and rapidly acquired a notoriety for every kind of brutality and extortion. It was several times destroyed and rebuilt, being finally abolished in 1842.

Fleetwood Lancashire port and holiday centre a few miles of Blackpool. The name is taken from Sir Peter Fleetwood whose house Rosall

Hall, was converted into Rossall School in 1844 Pop (1931) 22,983

Flemish Language This is a member of the Low German sub-branch of the Germanic branch of the Indo-European family of languages, and stands in very close relationship with English and Dutch. Originally the language of Flanders, it is spoken throughout N Belgium and by many thousands in the Nord department of France. It differs from Dutch and, especially, from English in its conservative retention of inflections. See also TABLE INDO-EUROPEAN LANGUAGES

Flemish Literature, see BELGIAN LITERATURE

Flemish School, term used for the pictorial art of the Netherlands in the 17th cent. In sculpture there can hardly be said to have been a distinctive Flemish School, the carved fonts, altars, and other architectural ornamentation of the Middle Age in the Netherlands being of the same general type as other Gothic sculptures of the period. But in painting a national school came into existence in the early 15th cent. and continued into the 17th cent.

The history of Flemish painting begins with Hubert van Eyck (c 1370-1426) (qv). At the end of the 14th cent. a school began to develop at Cologne, where a group of painters succeeded in evolving from the flat and formal outline work of the early Gothic art (a survival of which can be seen in the court-cards of the ordinary playing-packs of to-day) the first beginnings of realistic figure painting in N Europe. It is probable that Hubert van Eyck studied in Cologne or at least came into contact with the work of this group before he and his brother Jan settled in Ghent, where they subsequently attained great fame. They not only invented and perfected the method of painting in oils, but brought to the religious fervour which characterised all early Gothic a force of personality and a power of representing nature which make *The Adoration of the Lamb* altarpiece one of the greatest

masterpieces of European art. Roger van der Weyden and Dierck Bouts were the next outstanding figures of the Flemish School. They were born at the beginning of the 15th cent., and still retained many primitive characteristics, although there is a liveliness of arrangement and of portraiture in their work, which shows considerable individuality. Some thirty years later came Memling and van der Goes, who lived until near the end of the century. Quentin Matsys (1466-1530) brought to the art of painting a greater freedom



A Philosopher, by Quentin Matsys

of style and an advance in realistic portraiture. Mabuse (c 1472-1536) was the first of the Flemish painters to visit and work in Italy, and to introduce to the art of his native land the influence of Leonardo and the Italian masters. The change of style can clearly be seen in his portrait of Margaret Tudor in the Edinburgh National Gallery. It is compared with Van Eyck's *Man with the Pink* in Berlin or Memling's *Duke of Cleves* in the National Gallery. But while this Italian influence persisted in Flemish art for many years after the time of Mabuse, another and purely native

school was developing the earliest masters of which were the Brueghels, whose landscapes and genre paintings brought something entirely new to the history of art. Finally in 1577 Rubens was born and Flemish art again reached the supreme height which it had attained with the Van Eycks but now it no longer expressed religious devotion and a stern simplicity and realism of outlook intense love of life delight in strenuous action forms flowing in movement rhythmically balanced compositions of 3-dimensional complexity the texture of flesh and of rich fabrics—these now became the dominant characteristics of the Flemish School. Through Van Dyck considerable influence was exerted on British painting. Teniers and Brouwer continued and developed the tradition of genre painting. Snyder became famous as a painter of still life and of game while Jordens and Van Dyck carried on the tradition of Rubens. But Flemish art was not again to attain such pre-eminence and since the death of Rubens down to the present day there has been no Flemish artist of the first rank. Belgian art in recent years has been chiefly influenced by that of France and Constantin Meunier (1831-95) the sculptor is probably its most outstanding figure.

Flesh fly a fairly large fly with the thorax banded and the abdomen blotched with black and grey. The larvæ born in the active stage feed according to the species, upon decaying organic matter or upon earthworms, snails, insects and other animals. A large species found in Russia deposits its larvæ in wounds of domestic animals or in the ears and noses of human beings causing great suffering and is probably instrumental in carrying foot-and-mouth disease in that country.

Fletcher Sir Banister Flight (b 1866) British architect was educated at University College London and the Royal Academy. During his architectural career he has been awarded many honours among them the

Architectural Association Medal for Design the Tite Medal for Architectural Design and the RIBA Essay Medal. He was assistant professor at King's College London and is now staff lecturer on Architecture at London University. In 1908 he entered the legal profession and was called to the Bar. He was chairman of the City of London School from 1914 to 1915 and Senior Sheriff of the City of London from 1918 to 1919. He was knighted in 1919. He is the author of several works including *The Influence of Material on Architecture* & *A History of Architecture on the Comparative Method* and *The English Home*.

Fletcher Giles (1549?-1611) author is best known for his travel book *Of the Russe Commonwealth* (1591) and for a sequence of love sonnets (1593) generally ascribed to him. He was the father of (1) **GILES FLETCHER** (1588?-1623) poet whose fame rests on *Christ's Victory* (1610) the melody and passion of which show Spenser's influence and (2) **PHINEAS FLETCHER** (158-160) poet the author of *The Purple Island* (1633) an allegorical poem in the manner of Spenser. He also wrote pastoral and religious poetry. His language is colourful but his style involved.

Fletcher John (1579-1635) dramatist son of a Bishop of London whose death left him penniless. He took up dramatic work and began in 1584 to collaborate with Francis Beaumont (qv).

Fletcher J S (b 1863) English novelist is the author of many popular detective stories. They include *The Charing Cross Mystery* *The Safety Pin Murder in the Square* and many others. Among his more serious novels are *The Wonderful Wapentake* (1894) *The Making of Matthias* (1897) and *The Talking Floor* (1907).

Fleur-de-Lys [FLEURDELYS] (French flower of lily) heraldic representation of an iris or garden lily the armorial bearing of the kings of France from 1147 borne also by

British families As an architectural decoration the fleur-de-lys is very ancient, notably in Egypt and India

Fleuriau, Aimé Joseph de (b 1870), French ambassador to Britain 1924-33, Secretary (1898-1921) to the French Ambassador, the late Paul Cambon, first at Constantinople and then at London He was French Minister in China for the following three years

Fleury, André Hercule de (1653-1743), French cardinal and statesman He became bishop of Fréjus in 1698, and was later tutor to Louis XIV's grandson, afterwards Louis XV In 1726 he supplanted Bourbon as Louis XV's first minister, carried out financial reforms and economics, and constructed roads Fleury preserved peace with Britain, but was forced into the War of the Polish Succession (1733) and the War of the Austrian Succession (1741) He died shortly after the French failure in Bohemia

Flicker Photometer, see PHOTOMETRY
Flies, insects (*qv*) of the order Diptera, distinguished by their single pair of membranous wings (the front pair of other insects), the hinder pair being reduced to small pin-like structures, the halteres, which control flight The mouth parts are suctorial, usually forming a proboscis, but sometimes modified for piercing Metamorphosis is complete, the larva being legless and usually grub-like There are 50,000 known species of Diptera

Feeding habits vary greatly in both perfect and larval stages and thus there are differences in structure, particularly of the mouth Some flies prey on other insects, some feed on the nectar of flowers or other sweet substances, others suck the blood of land vertebrates and so, as possible transmitters of blood parasites to man, give the Diptera the greatest economic importance of all insects Dangerous also to man as carriers of disease germs are the species which lay their eggs in decaying organic matter The larvæ of many species are serious pests to farmers and gardeners

As a rule, female flies produce and

deposit a large number of eggs; but in several species, such as the tsetse fly and flesh fly (*qv*), the eggs are hatched within the parent, which deposits active larvæ In these cases the number of eggs that mature at a time may be perhaps only one A remarkable instance of larval reproduction is furnished by a species of the so-called gall midges (*qv*), in which the larvæ, by a process of internal budding, give rise to others which feed on the parent form and upon emerging repeat the process during the winter months, then pupate and turn into mature midges

The larvæ themselves vary considerably Those of the gnat, for instance, have a large head with well-developed antennæ and three pairs of jaws, whereas the maggot of the blow-fly has a narrow pointed head without antennæ, and the jaws are reduced to a pair of retractile hooks Almost every gradation is traceable between these two extremes The pupa of the gnat also differs greatly from that of the blow-fly It emerges from the larval skin showing the encased wings, antennæ, and legs of the adult, and leads a free, more or less active, life The blow-fly pupa, however, remains within the larval skin, which hardens into a protective covering

These two familiar Diptera illustrate the range of structural variation in the mature stage, the gnat with body, legs, and antennæ long and slender and the jaws piercing, and the fly with a body short and broad, antennæ and legs relatively considerably shorter, and the mouth parts modified as a sucking proboscis

Flies are found all over the world The best preserved fossils, which differ little from existing forms, occur in amber deposits of Oligocene age in the Baltic Provinces See also HORSE FLY

Flinders, Matthew (1774-1814), British navigator After serving in the Navy, he went to Australia in the *Reliance*, and with George Bass, the ship's surgeon, explored much of the Australian coast and Tasmania (1795-

9) In 1801 as commander of the *Intestigator* he went out in charge of a scientific expedition and circumnavigated Australia. His *Voyage to Terra Australis* is a valuable scientific work on hydrography and navigation.

Flinders Petrie Sir W M see PETRIE SIR WILLIAM FLINDERS

Flint, a dark grey or dark brown hard brittle substance composed almost entirely of silica with a certain amount of impurities. It occurs mainly in the Upper or White Chalk being found as nodules or veins. The layers of flint are not always parallel to the stratification of the Chalk and probably were laid down in cracks after the latter was somewhat consolidated.

Chert is a form of silica closely allied to flint, but typical of Palaeozoic rocks such as the Carboniferous Limestone and found to some extent also in the Upper Greensand. The most famous deposit in Great Britain is the Rye Chert of Devonian age in Scotland in which the embedded plant remains show remarkably minute detail.

Both chert and flint were used by prehistoric man for making weapons certain kinds of flint being more suitable than others. Later flints were used to produce a spark when struck by steel and hence were employed in fire-arms the principal British factory being at Brandon in Suffolk where the industry still lingers on. Flints are also used as gravel for by roads but are too brittle to be good metal. Powdered flint is used in making pottery and the rounded beach flints common in S.E. England are sometimes employed as grinding stones.

Flint Implements, see STONE AGE

Flint-lock see GUN

Flintshire, a small Welsh county on the N.I. coast bounded N. by the Irish Sea, W. and S. by Denbighshire and E. by the R. Dee and Cheshire with the small detached area of Maestir to the extreme S.W. of Cheshire. The two principal rivers are the Clwyd and the Dee. The mineral deposits, which have been worked for centuries include coal, iron, limestone and some

lead. Industries are smelting, metal founding and the manufacture of chemicals with a little rough pottery and of late years some artificial silk. Flintshire has considerable agriculture growing chiefly vegetables and oats. Stock raising is widely successful. The industrial districts have fostered dairy farming. There are indications that the Romans exploited the minerals to some extent. In Norman times the Welsh succeeded in holding the hills and for a period Flintshire was a centre of Welsh nationalism. The chief towns are Flint the county town Rhyl Mold and Buckley. Area 956 sq m pop (1931) 110,849.

Floater, share certificates, stocks and bills accepted by banks as security against a loan of call money i.e. money which can be called in on demand. Floaters are usually confined to first class bills and gilt-edged stocks.

Floating Debt, that part of the National Debt consisting of very short term obligations contracted to cover a temporary deficiency in national revenue. Treasury Bills and loans from the Central or State bank are its commonest forms and these are usually created or borrowed in anticipation of future revenue. Where there is no anticipation the creation of a large floating debt is a direct form of inflation. During the World War the Treasury Bills issued by the British Government reached £1,000,000,000. They are usually of 3 months currency. In 1919 the creation of Treasury Bill was authorised in the U.S.A. in place of the previous Treasury Certificate system.

Flodden, district near the northern border village of Branxton the scene of the battle (1513) in which the Scots under James IV were decisively defeated by the English. Almost every notable Scottish family was involved in the disaster and the King as well as a host of his nobles was among the slain.

Flood, The see DETECTOR.

Flood Lighting see LIGHTING, ARTIFICIAL.

Floods, inundations of land by water, usually resulting from the overflow of rivers following heavy rainfall or the melting of snow. They are seasonal occurrences in many parts of the tropics during the heavy rains of the wet season. Floods are largely dependent on the nature of the soil. On impervious rocks the water is rapidly carried away by rivers, which consequently are quickly in flood following heavy rain, but low at other times. In limestone districts, or over other porous rocks, the rain sinks into the ground, and the rivers flow steadily. The summer Nile flood of Egypt is remarkable as taking place in a region of very little rainfall, being produced by the melting of the snow on the hills of Abyssinia, together with the heavy rainfall at the sources in Central Africa.

Floors and Floor Coverings Nothing enhances the appearance of a room more than a good floor, and for those who can afford the initial outlay hardwood floors are a sound investment for living-rooms. The ever-popular oak parquet flooring, if of reliable quality and well laid, is indefinitely durable and a great decorative asset. It may be laid in several designs, from the plain herring-bone usually seen to more elaborate patterns in woods of different colours. To keep the floor clean and light in colour it should be regularly waxed with polish thinned with turpentine well beaten to creamy consistency. This should be sparingly applied and well rubbed off. Once, or preferably twice, yearly the floor should be scrubbed with turpentine and allowed to dry thoroughly before being re-waxed. This treatment will keep the floors clean and light in colour.

Oak board flooring, laid in narrow strips down the length of the room, is another good type. It is usually finished a dark oak colour. When building a house this flooring can be laid straight out on to suitably spaced joists, thus saving the expense of a sub-floor. Plywood is also used for

flooring, and may be stained with chemical stains in attractive colours, such as silver, grey, and shades of fawn.

For kitchen and other service rooms jointless composition floors are particularly practical. These have a basis of magnesium chloride cement, and are laid in a semi-liquid state, afterwards hardening. They may be laid with a coving between floor and wall, and are thus particularly hygienic. The best method of caring for them is usually by wax polishing, and initial applications of linseed oil are sometimes advocated.

Particularly suitable for bathrooms, but somewhat expensive, are floors of rubber or cork tubing. The cheaper rubber "carpeting" is made $\frac{1}{4}$ - $\frac{3}{4}$ in in thickness and 3-4 ft wide, and is laid in the same way as linoleum. Well-seasoned wood is the best foundation, though it can be laid on a concrete floor provided it is level, smooth, and dry, points which also apply to linoleum. This carpeting is made in plain colours or marbled designs, which do not show footmarks, etc., so readily. It may be kept clean by scrubbing with soft soap and hot water or polished with a turpentine-free wax.

Linoleum is popular, cheap, and reliable, if of the inland cork variety; in the printed type, since the pattern is only on the surface, it wears off in the course of use. A granite or jaspé pattern is excellent, though there are patterned linoleums in infinite variety for those who prefer them. Linoleum should only be scrubbed when absolutely necessary, for frequent scrubbing dries the oil used in the manufacture of the linoleum, opens the grain, and allows dirt to penetrate. The surface should be regularly wax-polished, when a protective coat of wax will result. When dirty the floor may be cleaned with turpentine in the way suggested for parquet floors.

When choosing carpets the use to which the room will be put should be considered. A plain colour is not practical for living-rooms, especially



GLOUCESTER CATHEDRAL FROM THE EAST



GOYA DOÑA ISABEL COBOS DE PORCEL
(In the National Gallery)

dining rooms owing to its greater readiness to show dirt. In the dining room a Wilton or Axminster with a small all-over pattern is a wise choice. Indian carpets are also suitable but are not so popular as they were formerly. There are also a wide range of short pile carpets at very moderate prices imported into this country particularly from Eastern Europe. Generally speaking it is best to avoid any seams in a pile carpet and if the room permits a square carpet this is to be recommended as it may be turned about to equalise wear. Hair cord is inexpensive and very durable and is an excellent all-over covering for a floor. It is made in many plain colours and a variety of patterned squares some of which are reversible. There are rugs of many kinds from hair cord to the rare hand made products of China and Persia. Between the two are some less well known and unusual varieties. Albanian rugs made in formal and geometric designs and the hand made rug from Scotland with the traditional Scotch designs.

For the nursery washable and fadeless rugs are best. They are made with designs of animals toys etc. as are also the cheaper crawling rugs of cotton or terry. For the playroom of older children a hair-cord carpet with suitable designs is a good choice.

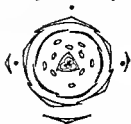
For stone and tiled floors there are several kinds of string and fibre mattings made in attractive colours and designs.

Flora. (a) the plants of a district or of a particular kind of habitat. (b) a book describing flowers to aid their identification. The most valuable **Flora** of the British Isles for general purposes is the classical work of Bentham and Hooker (new ed. 19th) which describes each plant carefully and accurately in non-specialised language and is illustrated. See also **ECOLOGY**.

Flora, in Roman mythology the goddess of flowers (Gr. *Chloris*) the wife of Zephyrus.

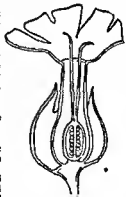
Floral Diagram a method of depicting the essential structures of a flower in the form of an ideal transverse section the part being represented as if all on the same plane.

In a typical flower the ovary including the ovules is shown in the centre surrounded by one or two



whorls of **Floral Diagram** of Caryophyllaceae stamens and outside these in two concentric circles are the petals and sepals forming respectively the corolla and calyx. The individual petals and sepals are joined together or depicted as separate according to the condition in the particular flower.

When a bract is present it is shown as a large sepal distinct from the others at the bottom of the diagram and the bracteole opposite it at the top. The line through the bract and bracteole being the arbitrary line through which longitudinal sections are made.

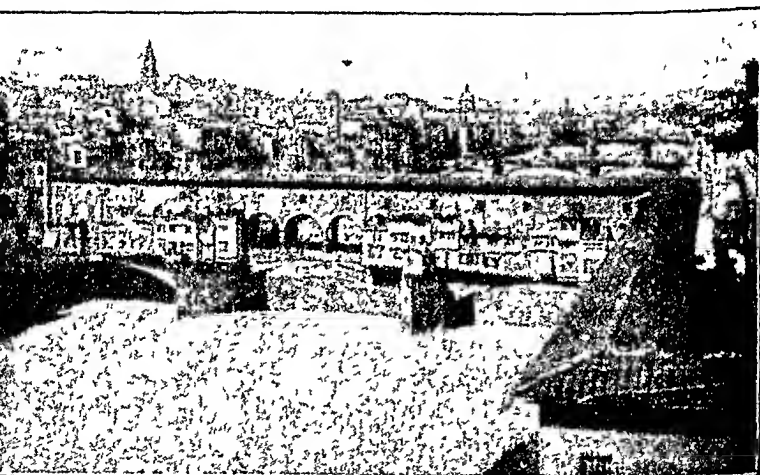


These structures are illustrated in the accompanying floral diagram and longitudinal section of the Longitudinal Section of Flower

Caryophyll of the Caryophyllaceae Family **laceae** a family of flowering plants including several well known British forms such as the pinks, campions, ragged robin and chickweeds and the cultivated carnations and sweet

lliams They are herbaceous plants, characterised by opposite undivided leaves and stems swollen at the joints. Florence (*Firenze*), a historic city, capital of a province of the same name, Tuscany, Italy. It is situated on the R Arno and lies in a fertile district of fruit, wheat, and flowers of all kinds now in abundance. Wine production is important. The industries include flour-milling, glass and porcelain manufacture, and iron-founding. Florence is famed for its fine buildings and historic associations, which attract

taining many rare volumes and MSS which is housed in a building designed by Michelangelo. Florence is rich in picture galleries and museums. The chief galleries are the Uffizi and the Pitti, which contain magnificent collections of the early Italian masters, as well as of Flemish and other schools, and much fine sculpture. In the Bargello is a museum of sculpture, enamel, and bronze work, and in St Mark's museum are many of Fra Angelico's paintings, and authentic relics of Sironarola, the Etruscan



Florence Ponte Vecchio

great tourist traffic, one of its main sources of revenue.

Among the many beautiful churches are the Duomo, begun in the late 13th cent., and not finished until the 19th, the Campanile, built by Giotto, with the superb 13th-cent. baptistery opposite, and the Badia, Santa Trinità, and San Lorenzo. Famous palaces include the Palazzo Riccardi, once the home of the Medicis, now of the prefecture, the Antinori, now the British Institute, the Palazzo Vecchio, the Pitti, which was the old royal palace. Among its libraries is the Biblioteca Mediceo-Laurenziana, con-

taining the most important Etruscan remains still extant. The university dates from the 14th cent. The city, with its associations and picturesque surroundings, is one of the most beautiful and interesting in Europe. It was the birthplace of Donatello, Machiavelli, Dante, and Ghiberti. Most of the great figures in Italian art and history have been connected with the city.

History—Florentia was for many years a Roman colony, and later became part of Tuscany. It was bequeathed to the Pope by the Countess Matilda in the early 12th cent., and thence began

to grow in importance and wealth. Trade guilds were established and rapidly grew in power and importance. The local nobles were either subdued or brought by agreement into union with the city and by the middle of the 13th cent. Florence declared itself an independent republic. Power passed into the hands of the great merchants and in spite of local strife the city continued to prosper. The plague (1348) was a severe check to the growing prosperity. In the next cent. the

which in the 16th cent. ceased to be independent and was reincorporated with Tuscany which was ruled by the Medici until 173. Under Napoleon it became capital of Etruria and of United Italy (1861-71) until that position was taken by Rome during the Franco-Prussian war. Pop. (including commune) 316,300.

Florentine, an alternative name for the recently (194) discovered rare earth element of atomic number 81 which is also known as thulium (qv).

Flores (1) Mountainous and forested island of the Dutch E. Indies (qv) in the Lesser Sunda group I of Java. It is not as yet fully explored. The soil is fertile and crops of maize, rice, coffee, tobacco, cotton and cinnamon are produced. Mother-of-pearl and copra are valuable exports. The natives are backward but amenable to Dutch influence through the native chiefs. The principal towns are Labuan Lideh and Reo. The island is governed from Timor. Area 5830 sq. m. pop. c. 433,000.

(2) Island in the Azores where Sir Richard Grenville lay before his historic fight with a fleet of 53 Spanish warships. Pop. 7000.

Florida, the most southerly American State forming a peninsula between the Gulf of Mexico and the Atlantic. The surface is low lying and swampy, the Everglades a gigantic swamp being nearly 4,000 sq. m. in extent. The climate is equable and many areas are extremely fertile, producing fruit, vegetables, maize, cotton, tobacco and sugar-cane. There are large forest areas and timber is one of the chief industries of the State. Cattle and pigs are largely raised and sheep and horses in smaller numbers. Coastal fisheries are of great value and also provide sport for the large holiday population. Minerals include phosphates and fuller's earth. Developments in drainage and communications since the World War are bringing huge areas into cultivation. The chief towns are Tallahassee, the capital, Jacksonville, Miami, Tampa and Palm



Florence The Florence Cathedral

Medici family originally bankers began to take a leading position. Cosimo, an immensely wealthy merchant, was the first of note and the greatest was Lorenzo, the Magnificent. They were generous patrons of the arts and learning. Their aims at royal power caused their expulsion on several occasions from the city. During the century of Medici power the Florentine school of painting included Cimabue, Leonardo da Vinci, Giotto and del Sarto. The territorial ambitions of the family coincided partly with a decline of Florence.

Beach, a fashionable holiday resort. St Augustine is the oldest town of European origin in the United States. Florida was discovered by Ponce de Leon, one of Columbus's officers, in 1513, while he was searching for the island possessing the fountain of eternal youth. It remained Spanish until the Napoleonic era, when it was acquired by the United States. A treaty with Spain in 1819 recognised American dominion. The E coast was devastated by hurricanes in 1926 and 1932. Area, 58,650 sq m, pop (1930) 1,468,000.

Florin, name for several European gold or silver coins, but usually applied to a British silver coin of the value of two shillings, first issued in 1849. Until 1852 the "Dei Gra," or D G, was not stamped on it, for which reason it was called the "graceless florin." From 1887 to 1890 a double florin was issued. The silver florin of Louis Napoleon of Holland, struck in 1807, became the Dutch gulden. Among gold florins of interest is the original coin struck at Florence in 1252 which gave its name to the modern coins. This bore the figure of St John the Baptist, and on the reverse side the Florentine lily. In the 14th cent gold florins were minted in Anjou, Luxemburg, and by Edward III of England, the latter, 6s in value, was current only one year.

Floris and Blanchefleur, the title given to an episode very common in the cycle of mediæval romances which draw upon the legends and stories of antiquity for their material. It tells of the difficulties and dangers of two lovers, their separation and final happy reunion. Its source was a lost Greek or Byzantine original, and it has a long European history, appearing in 12th-cent French romances, in Boccaccio's *Filocolo*, and in translations in nearly every European language.

Flotsam, Jetsam, and Lagan (law), flotsam, goods floating upon the sea, which belong to the Crown unless claimed within a year and a day. *Jetsam, jettison, or jetson*, goods thrown

overboard in a storm, or after shipwreck, and cast upon the shore, technically included in "wreck" (*qv*).

Ligan, a wreck consisting of goods sunk in the sea but tied to a buoy so that they may be found again.

Flounder, one of the flat-fishes (*qv*) related to and closely resembling the plaice in having among other similarities the left side beneath, but differing in being smaller, in coming to maturity when the female is about 7 in and the male 1½ in long, and also in habits. The spawn, comprising sometimes a million eggs, is laid in shallow water, and the young fish ascend rivers for some distance, returning to the sea on attaining maturity.

Flour-milling, see CRUSHING AND GRINDING.

Flower. The flower of a higher plant consists of one or two whorls of enveloping leaves surrounding the stamens and carpels, which are the organs essential for sexual reproduction. The outer series of leaves (the calyx of sepals) has a protective function, and the inner series (or corolla of petals) is usually conspicuous and attractively coloured in plants which are insect-pollinated. The stamens are the male organs and the carpels the female. All these parts of the flower are regarded as modifications of the foliage leaf, which has gradually changed its form to accommodate itself better to its particular function. See INFLORESCENCE.

Flower Arranging. Flowers must be considered against their background and disposed to show their beauties and increase the charm of their surroundings. Those flowers which have long graceful stems, such as Japanese anemones, should be put in long slender vases which hold only a few sprays. A single branch of fruit blossom, in a heavy vase which will carry its weight, is delightful in a room with furnishings in quiet colours, and is best placed in a corner, where the delicate petals may be seen in relief against a wall. Marigolds, being short-stemmed and brightly coloured, should be put in a short

wide bowl and arranged in an even flat expanse of gold orange and brown their stems should be cleared of leaves as they decay quickly in water. Bowls and vases of plain design and neutral colouring are preferable.

Flue-pipe *see* ORGAN

Fluke (or *Linc. Fluke*) is a parasitic flat worm (*qu*) found in its mature condition in the liver of sheep causing a serious usually fatal disease known as liver rot. The eggs are passed with the droppings of the sheep and hatch in damp places producing a larva which bores its way into a water snail and undergoes a complicated series of changes ultimately turning into a tadpole-like phase which crawls into the grass, becomes encysted and waits to be eaten by a sheep in the liver of which it becomes the mature worm. The name is derived from the resemblance of the worm to flat fish like flounders which are sometimes called flukes. Fluke is also a term for the tail fins of whales.

Fluorapatite, a common mineral consisting of a mixed phosphate and fluoride of calcium corresponding to the formula $\text{CaF}_2 \cdot 3\text{Ca}(\text{PO}_4)_2$. It is a source of phosphorus and was formerly used to make phosphate fertiliser. It is also employed as a source of fluorine compounds.

Fluorescein, an organic compound obtained by heating together phthalic anhydride and resorcinol. It is a red powder insoluble in water but it dissolves in alcohol and also in alkalis giving a brilliant green fluorescence; the colour of the solution is however red-orange. Fluorescein is used in the manufacture of dyes and also sometimes as a dye for animal fibres.

Fluorescence, a change in colour by certain materials when suitably illuminated. For instance a solution of quinine sulphate normally colourless gives a brilliant blue fluorescence. The phenomenon was first observed in the mineral fluor spar hence the name. When light falls on a fluorescent substance it is reflected back as a

different colour the wave length of the reflected light usually being greater than that of the incident light since the act of reflection absorbs a certain amount of energy and the energy of light decreases with an increase of wave length according to Stokes' law. Many substances which do not fluoresce when illuminated by ordinary light exhibit visible fluorescence on illumination with an ultra-violet lamp a property of considerable value in distinguishing by a rapid and simple physical method materials which can otherwise only be differentiated by prolonged chemical and physical tests. The ultra-violet lamp is nowadays used considerably in the analytical laboratory as a rough guide to the genuineness or otherwise of many materials such as fabrics ancient paintings various fats and oils etc. The indications it gives are in many cases insufficient for a definite opinion to be based on them alone but they are of great help in indicating the true nature of the material under examination and this can then be confirmed by other methods.

Fluorine a gaseous element belonging to the group known as halogens. It is the most chemically reactive element (many substances ignite spontaneously in it) and for this reason is never found uncombined; it is however widely distributed in nature the chief source being fluor spar or calcium fluoride CaF_2 . It is also found in small amounts in bones and teeth. Elementary fluorine is difficult to prepare on account of its great reactivity and although the existence of the element was known in the beginning of the 19th cent. it was not till 1886 that the pure element was obtained by Moissan by the electrolysis of liquid hydrofluoric acid rendered conductive by dissolving in it potassium hydrofluoride. Pure fluorine is a pale green yellow gas which is very poisonous.

Fluorine in the elementary state is never employed for any purpose except scientific investigations but hydrogen

fluoride (*Hydrofluoric acid*), HF , which may be prepared by the action of sulphuric acid on fluorspar, is a fuming liquid which boils at 19°C and is very soluble in water. The aqueous solution is used for etching glass.

Fluorspar (*Fluor*, or *Fluorite*), calcium fluoride, occurring in cubic crystals, or more rarely in other shapes, and sometimes in masses. The crystals are often of beautiful colour, violet, green yellow or rose-coloured. The dark violet kind found in Derbyshire is termed 'Blue John'. Fluorspar is widely distributed. It is found in the mines of Cornwall and S. Devon, where it was probably deposited from hot vapours in the carboniferous limestone of the N. of England in Saxony the Alps, and the United States. It is important as a source of fluorine and hydrofluoric acid and as a flux in reducing metallic ores.

Flushing, Dutch port of Zeeland, on one of the most popular routes from England. A large passenger traffic is handled yearly and there are several small manufactures connected with the shipping. Agricultural produce is exported, and Flushing is in some reputations as a holiday centre. Pop (1932) 21,750.

Flute, see *ORCHESTRA*.

Fly, see *FIERCE*.

Flycatcher, a small, dull-coloured, songless bird, the typical representative of an ill-defined family related to the shrikes (*q.v.*). It is a summer visitor to Great Britain and takes its name from the skill with which it catches small flies on the wing.

Fly-fishing, see *ANGLING*.

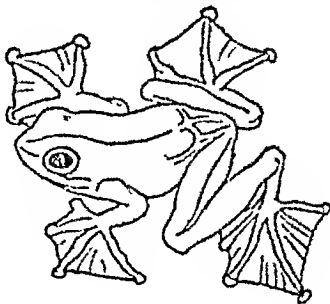
Flying, Blind, see *AIRIAL NAVIGATION*.

Flying Corps, see *AIR FORCE*, *ROYAL*.

Flying Fish, a name for several species of bony fishes in which the pectoral fins are lengthened and wing-like and serve to sustain the fish in its short flights through the air. In the typical flying fish these fins act merely as floats to prolong the leap taken from the water, but in the Flying Gurnard they are rapidly flapped, the flight resembling that of a locust.

Flying Fox, see *BATS*.

Flying Frog, closely allied to the common frog, but adapted for living in trees, having adhesive discs at the tips of the toes, which are very long and fully webbed so that when spread they



Flying Frog

are capable of acting as a parachute to prolong the leap to a distance of several yards and to check rapid descent to the ground.

Flying Lemur, a mammal not related to the lemurs (*q.v.*), but more nearly akin to the Insectivores (*q.v.*), differing, however, sufficiently to be placed in a distinct order, *Dermoptera*. It ranges from the Malay Peninsula to the Philippine Islands, and is represented by several species, all arboreal in habit and feeding on leaves and fruits. Its chief external peculiarity is the extension of wide flaps of skin between the limbs and body and tail by means of which it is able to take prolonged floating leaps from tree to tree over a distance of 70 yards or so.

Flying Squirrels, squirrels in which the skin of the body between the fore and hind limbs is developed into a wide flap, which enables them to continue a leap by floating some distance through the air. Some small species about the size of rats are found in N. America, E. Europe, and Central Asia, but in the tropical parts of Asia these squirrels considerably surpass the common squirrel in size. The so-called African Flying Squirrels, although similarly modified, are not

squirrels but belong to another family of rodents

Flysch, a geological formation extending from Switzerland across the Alps to the plains of the Danube at Vienna where it is called the Vienna Sandstone on into the Carpathians and thence into the Balkans. It consists of a mass of sandstones, shales and marls which have been variously considered as the product of mud volcanoes or as a normal water deposited formation. The rarity of fossils makes the determination of its exact age difficult but the chief development appears to be Oligocene though in W. Switzerland it is Eocene in the F. Alps Upper Cretaceous and at Vienna Lower Cretaceous in age.

Fly wheel, a heavy wheel whose inertia maintains a nearly uniform speed of rotation under variable load or driving force. The revolving fly wheel is a reservoir of energy by virtue of its moment of inertia (see DYNAMICS) and its effectiveness depends on the amount of energy which it absorbs or gives up for a given change of speed. When a metal is punched from the sheet by a press the power required is momentarily very great and it would require a very powerful motor to deliver it directly, but if the power is taken from a heavy rotating fly wheel this is slowed up only slightly and can be speeded up again between each blow by a comparatively small motor. The fly wheel is used to steady the motion of all piston-driven stationary engines and carries the motion over the dead point.

Foch, Ferdinand (181-199) French marshal joined the Army in 1871 entered the staff college and was lecturer on military history and strategy. He was appointed general in 1907 and commanded the 9th Army at the first battle of the Marne (1914) and the first battle of Ypres. He directed the French armies at Arras (1915) and at the Somme (1916). In April 1918 he was made generalissimo commanding the Allied forces

Under his direction the great German offensive was checked and turned at the Marne (July 1918). He followed up this success with a series of rapid attacks culminating in the German surrender Nov. 11. Foch imposed the conditions of the Armistice and later presided over the Inter Allied military commission. His works include *Principes de la Guerre* and *Conduite de la Guerre* in which he bases his principles on those of Napoleon.

Focus see LENS OPTICS PHOTOGRAPHY

Fodder all manner of foods given to horses, cattle and other animals. It includes grass or any plant eaten green or the same dried for convenience sake or for use in winter and grain, beans, peas, etc. or artificial products (such as linseed cake) made from any nutritive material.

Fetus see REPRODUCTIVE SYSTEM

Fog a low lying cloud without definite shape which drifts slowly over the surface of the land or sea. Fogs especially those at sea are often called mists and the terms are to a large extent interchangeable though popularly fogs are regarded as composed of thicker masses of vapour than mists and on land over large towns are usually darkened and often coloured yellow by smoke and other impurities. The familiar high yellow fogs which darken cities in winter without obscuring the low levels of the atmosphere are by reason of their height and method of formation not true fogs.

While clouds are formed by the cooling of ascending currents of air carrying water vapour in considerable quantities fogs are due to the slow mixing of damp air of varying temperature. At sea the cold water may cool the adjacent air and precipitate moisture the cooling effect extending upwards. Thus the converse of the conditions of cloud formation is shown the surface layer being cooler than the air above. Sea fogs are most frequent when the air is warmest as in spring and summer and may be present even when there is considerable movement

in the air. Indeed, it seems that movement of the air, which enables mixing of currents at different temperatures, is necessary for the production of fogs, both on sea and land. Nevertheless, the fogs or mists which occur in the evenings on low-lying meadows and in valleys are favoured by absence of wind. They are due to loss of heat from the surface of the earth cooling the adjacent air, which settles in the valleys, the slow movement mixing it with warmer air and producing the conditions suitable for precipitation of moisture, which is also helped by vapours rising from the warmer soil and water surfaces.

Foggia, Italian town and market centre, in Apulia, capital of a province of the same name. It has long been a famous wool market, and is situated in a plain suited to sheep-rearing and the production of wheat. Parts of the cathedral are 12th cent. Pop. (commune) 80,000.

Föhn Wind, see WINDS

Foil, in metallurgy, a term for a thin sheet of metal intermediate between a leaf, such as gold leaf, and sheet metal. It varies in thickness according to the constituent metal or metals. Very thin tinfoil is used for backing mirrors, and in chemistry and electricity. Tinsel, of theatrical use, is thicker. Dutch foil is specially coloured for backing artificial gems. Commercial "tinfoil," used for wrapping tobacco, chocolates, and various household foods, is made of lead coated with tin. Japanese foil is of variegated colour, and is made by soldering together the edges of several thin sheets of gold, silver, copper, and other metals, then cutting a pattern through the sheets and rolling them out thin, the holes thereby disappearing. Gold foil is used by dentists. On account of its lightness, aluminium has been tried as a foil, but without much success.

Foils, see FENCING

Fokine, Michel, Russian dancer, and master of the original Russian ballet, to whom the modern renaissance of

ballet may be largely attributed. He was master of the Russian Imperial Opera House ballet before 1914. After the War his differences with Diaghilev (*qv*) were partly responsible for breaking up the latter's famous troupe. In 1923 he arranged the dances for *Hassan*, and in 1924 for a brilliant production of *A Midsummer Night's Dream*. He now teaches, organises, and is one of the chief authorities on stage dancing. He is married to a celebrated dancer.

Fokker, Anthony Herman Gerard (b. 1890), Dutch aeronaut and aeronautical engineer. He learned to fly in 1911 and established an aeroplane factory near Berlin (1912) and another at Schwerin (1913), which supplied aircraft designed by himself to the German Army during the World War, notably the giant triplanes which bore his name. After the War he established the Fokker Aircraft Works in Holland with German capital. Subsidiary companies followed in New Jersey, U.S.A., and at Madrid. Since the War, Fokker has been concerned with the possibilities and design of commercial aircraft.

Folds, curvatures in the beds composing the crust of the earth produced by pressure.

The beds are generally buckled into arches and troughs, known respectively as anticlines and synclines (*qqv*), the axis of folding being termed the axial plane. If one side of the fold is vertical, the structure is termed a monoclinical fold. Strong lateral pressure may incline the axis sideways, forming an "overfold," or inverted fold, which may even be tilted nearly horizontal, forming a "recumbent" fold. The varying plasticity of strata determines the extent to which they will fold without faulting. A big fold involving a large area of country is called a "geanticline" or "geosyncline," and this frequently includes a number of minor folds. These very large folds often give rise to chains of mountains (*qv*), generally as a result of lateral pressure.

Folkestone, a popular holiday resort on the Kent coast, S W of Dover. It shares the Cinque Port privileges of Dover, and is a port of embarkation for France. The town is beautifully situated, and commands a fine view of the English Channel. Roman remains and ancient British earthworks have been discovered in the locality. There is a grammar school (founded 1674) and a racecourse. Pop (1931) 35,890.

Folklore, see ETHNOLOGY

Font, the vessel, generally of stone, used in the Christian Church for holding the water for the sacrament of



15th cent font at Burford Church, Glos

Holy Baptism. Many fonts of the Middle Ages are decorated with sculpture and are interesting and beautiful objects of ecclesiastical art.

Fontaine, Jean de la, see LA FONTAINE, JEAN DE

Fontainebleau, a French town of Seine-et-Marne department, c 40 m S E of Paris, situated in the forest of the same name. The royal palace (12th cent) was for many centuries a favourite residence of the French kings. The district is much favoured by landscape painters. Sandstone is quarried

locally, and porcelain manufactured. Pop 15,500.

Fontainebleau, Treaty of (1807), between France and Spain, providing for the occupation of Portugal by those countries.

Fontenoy, a Belgian village (pop 950) some miles from Tournai, scene of a famous battle in the War of the Austrian Succession, in which an Anglo-Dutch and Austrian army, led by the Duke of Cumberland, was defeated by the French, under Marshal Saxe, in 1745. The special feature of the battle was the stubborn and valiant behaviour of the British troops, and "Fontenoy" is one of the most cherished battle-honours of the regiments that took part.

Foochow, a treaty port, and capital of the Chinese province of Fu-kien, c 30 m from the mouth of the R Min, it was formerly a great tea-exporting centre, but the opening up of the Yang-tse basin has diverted this traffic. Manufactures include paper, soap, silk, cotton, tinned foods, and bamboo goods. There is a fair coastal shipping trade which should increase on the completion of improvements in the river navigation. Pop (1931) 322,700.

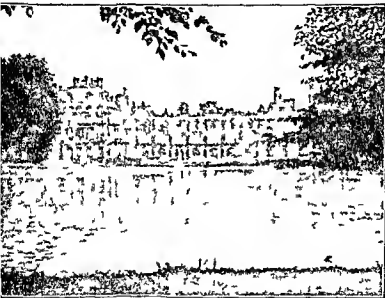
Food, substance taken into the body, and capable of being absorbed and utilised by the body for bodily energy and heat, and for growth and repair of wasted tissues. It is important to note, however, that mere quantity of food is not necessarily sufficient to meet these requirements. Its kind and quality are of utmost importance. Moreover, the food requirements of the individual vary with the changing habits of his life.

By far the greatest bulk provides fuel for the muscles, enabling them to contract and perform work. In the article **MUSCLES** it is explained how the muscles convert the energy of food into the energy of useful work; and how they are machines, but, in common with all machines, are not 100 per cent efficient, because the energy of food is not completely converted into the energy of work. Some

it is converted into heat which is dispensable to the warm blooded animals for if the animal becomes cold the muscles undergo the repeated and rapid contractions known as shivering.

The fuel required by muscles to enable them to contract is blood sugar the chief source of which is the sugar and starches in the food. The con

carbohydrates are economic sources of muscular energy and should form a large proportion of a mixed diet. In addition carbohydrates in the form of cereals are rich in vitamins and supply ballast for the bowel. Further reference will be made to these uses below. But it must be noted here that they also have their disadvantages if taken in excess.



Fontaine de la Paix

stitute carbohydrate and are represented by sugar itself, bread and potatoes. It is a familiar fact to any baker that the amount of bread sold is always higher in winter than in summer for in cold weather people unconsciously increase the carbohydrate part of their diet to suit their needs.

Blood sugar can be manufactured by the body from both proteins and fat but the process of conversion and is to some extent silence as such the

is not too rich in carbohydrates usually has a bad effect on the development of children. Children who are reared on a sterilized condensed milk get so much sugar that although they put on weight they become flabby and have a poor resistance to infection. Apart from this excess of sugar also often leads to infantile diarrhea. With adults too care must be taken. People who abuse their constitutions with too many sweet things are liable to get diabetes.

Other kinds of food are also required by muscles in the performance of their work. They slowly wear out, like every other tissue in the body, and a continual replacement of the worn tissue is necessary. Certain substances are therefore absolutely essential components of the diet of animals, not only for tissue repair but also for growth itself. These essential body-building units, though protein in their nature, are not always present in protein foods. Proteins of vegetable origin particularly are liable to be lacking in them. If, however, the food proteins are of mixed origin, there is no likelihood of their being inadequate. Examples of foods rich in protein are meat, milk, fish, eggs. The relative composition of the various foods in common use is shown in the diagram, and from this it will be seen to what extent they are body-builders, and to what extent they are energy-suppliers.

The third kind of food essential to man is fat, whose chief use is as a source of energy in a concentrated, though not an immediately available, form. A given quantity of fat has twice as much energy value as the same quantity of carbohydrate. Fat also plays an important part in protecting the body from the cold and, incidentally, in producing the rounded contours which give to the body beauty of appearance. As in the case of cereals, certain fats are valuable foods for other reasons.

Food, in man, must have bulk. In tabloid form, it would not stand the test of prolonged trial, for without bulk, a state of constipation is produced. Now cereals and vegetables contain much fibrous tissue which cannot be digested, and in passing into the bowel, this undigested part supplies the ballast which is so essential to ensure an easy evacuation. Fats then play their part, in that they are not completely digested, and the residue from them softens the contents of the bowel, and promotes an easy movement.

Another important function which fat food-stuffs have, in common with carbohydrates, is that they act as vehicles for those substances called vitamins. Vitamins are not used by body-builders, nor are they a source of energy, but their presence is essential for continued health and growth and reproduction. They have received names according to the mal-condition which their presence prevents. They have also been named with letters of the alphabet.

Two of them, A and D, are soluble in fats, and are present in fats of animal origin—beef fat, butter, milk, and cod-liver oil. In the absence of Vitamin A, growth is defective; the absence of Vitamin D, rickets follows. A is therefore known as the growth vitamin, and D as the anti-rachitic vitamin.

Two of them, B and C, are soluble in water. B occurs in the germ of cereal grains, in beans and peas, and in eggs and yeast, while C occurs in the green leaves of plants and in fresh fruits, most important of which are oranges and lemons. Absence of Vitamin B results in the disease known as beri-beri, which is a multiple neuritis with palsies, ending usually in heart failure; hence, B is called the anti-beri-beri vitamin. The absence of the anti-scorbutic vitamin, results in scurvy.

Besides the four foodstuffs already mentioned, there are other components of human food which are essential, but which, in common with the vitamins, play no part as suppliers of energy. Unlike the vitamins, however, these are simple chemical substances. Iron is necessary to prevent anaemia, iodine to prevent goitre, calcium, to ensure good formation of bones, sodium chloride, or common salt, to ensure a normal blood, and there are many other chemical elements which are necessary in minute amounts.

Lastly, there is water, and this is even more essential than food itself. A man will die sooner from thirst than

from lack of food. Without food he may last 8 weeks, without water he will last only 8 days.

Reference to **MUSCLES** will make it clear how food requirements can be calculated on the basis of work to be done by the muscles. A list is given here of the energy value of foods required by people of different occupa-

tions. It will be noticed that the food values are given in the form of calories, which term is also explained in the section above referred to.

The manner in which such food requirements are calculated is complicated and depends upon the following equation:

Food completely burnt in oxygen given off in amount per hour This heat is partly converted by the muscles to useful work The remainder is used by the body in warming

Heat value of food = Work done by body + Heat lost by body

or Oxyg. required to burn food in calorimeter = Oxyg. used by body doing work + Oxyg. used to keep body warm

100 Gms. of food

	Food Protein	Fat	Carb. hydrate	Water	Calories Per lb.
Protein Foods					
Meat (beef, undressed)	10-14	7	—	8	670
Fish	—	9-11	—	9-10	730-750
Milk	3	4	6	—	310
Egg	13	3	—	11	640
Cheese	26	32	3	—	1680
Carbohydrate Foods					
Sugars	—	—	100	—	1790
Sugar	—	—	70	—	1235
T. sac.	—	—	71	—	1290
Starchy foods	8	1	77	—	1640
Cornflour	1	1	71	—	1630
Flour (white)	11	3	71	—	1638
Flour (brown)	7	—	77	—	1620
Rice	—	—	98	—	1680
Oat meal	13	7	68	—	1700
Bread (brown)	7	2	46	—	1050
Bread (white)	7	1	52	—	1190
Banana	0-12	1-12	66-73	—	186-1990
Dried fruit	3	2	84	18	1000
Peas, dried	17	1	62	—	1350
Fresh fruit	0-1	0-1	8-17	4-25	130-330
Also containing foods					
Carrot	1	—	7	20	160
Parsnip	1	—	20	20	230
Fat and Fat Foods					
Butter	1	81	—	—	3410
Margarine	1	7	—	—	3320
Lard	—	100	—	—	4320
Oil	—	1	—	—	4320
Nuts	17	68	14	—	2900

FOODS CONTAINING MINERAL SALTS
Calcium for Bones and Teeth Formation

	Grains per oz
Cheese	514
Turnip tops	087
Filberts	081
Almonds	084
Mustard greens	082
Kale	06
Water cress	053
Figs	046
Egg yolk	039
Cauliflower	035
Olives	035
Milk	034
Cocoa	032
Buttermilk	03
Lentils	03
Lard	020
Chocolate	018
Walnuts	025
Cream	024
Currents	023
Beans	021
Peanuts	02
Oatmeal	02
Spinach	019
Carrots	016
Leeks	016

Iron for blood formation

	Grains per oz
Egg yolk	00241
Lentils, dried	0024
Tricale	00207
Beans, dried	002
Ham, lean smoked	00187
Peas	00162
Lard	00142
Wheat, shredded	00128
Filberts	00116
Almonds	00111
Oats, rolled	00109
Wholemeal flour	00105
Spinach	00102
Pork loin chops, lean	000651

Iodine

Fish, especially oysters and lobsters
Vegetables, especially onions
Cod liver oil
Iodised salt

Phosphorus (as P_2O_5)

Cheese
Egg yolk
Meat
Egg
Milk
Oatmeal
Wholemeal bread
White flour and bread
Green beans
Green peas
Cauliflower
Spinach

Food Control The shortage of food in industrial countries in time of war

when imports are curtailed by blockade and other causes necessitates national distribution of the available supply. The question was officially examined by a Royal Commission in 1903, and while confidence was expressed in the protective strength of the British Navy, it was pointed out that normally only 7 weeks' grain supply is held in the country at any one time. Submarine warfare from 1916 to 1918 made the question an acute one, and in 1916 a Food Controller was appointed later supported by a Ministry of Food. Meanwhile an allied commission controlled wheat supplies to Great Britain, France, and Italy. Sugar was first rationed in 1917 (8 oz per head per week), and many other articles followed, including butter and margarine (5-6 oz), lard (2 oz), meat (1s. worth), etc. The problem was eased towards the end of 1917 by the slackening of the submarine campaign and the active help of the United States in food supply.

Food Council, a body formed in 1925 on the advice of a Royal Commission to investigate charges of food profiteering and take action therein. It had few powers, and the natural fall in prices soon made its work unnecessary. It sponsored the Weights and Measures Act in 1926.

Food Poisoning, see POISONING, Food

Food Preserving Food is preserved on a commercial scale by canning (*qv*), which involves the use of heat and sealing in airtight containers; by drying and salting, or by storing in a cool chamber. Similar methods on a smaller scale are used in the home. Fruit is preserved by *bottling*, or *drying*, or may be made into jam, vegetables, by bottling in acids or salt solutions, eggs remain fresh in lime solutions, meat may be cooked and set in fat, excluding all air, or sun dried; fish keep if pickled or dried.

Fruit For bottling fruit should be well grown but not over-ripe, and may be placed whole in the jar, which is then heated in a moderate oven until

the skins of fruit begin to split. They are then covered with boiling water or a syrup of sugar and water. The jars may be filled with cold or hot water or syrup before cooking. Acid fruits—gooseberries, cranberries, green grapes—keep satisfactorily if the jar is filled with cold boiled water. Half a pound of sugar to a pint of water or fruit juice is required for larger fruit and $\frac{1}{2}$ lb to a pint for small berries. Wax poured on the surface while hot makes an efficient seal.

The usual English procedure is to heat the jars of fruit and cold syrup in water to 165–180° F for $\frac{1}{2}$ –1½ hours. The lids are partially screwed down during this process and tightened on removal from the water.

A quicker method is to immerse the jars filled with fruit and boiling syrup in boiling water until cooked. Glass or iron lids with rubber rings are placed in position and will be held tightly in place by a vacuum when the preserves are cold. A large stew pan, a fish kettle or an ordinary washing copper with wooden slats at the bottom is equally efficient. The jars require only new rubber rings each time they are used. Recently home canning machines sealing fruit in tin containers have been developed.

Vegetables. Most vegetables except tomatoes contain insubstantial natural acid to protect them against bacteria when bottled and preservatives must be added as lemon juice, vinegar or salt. A solution of $\frac{1}{2}$ oz. of salt or a gill of lemon juice to a gallon of water is very suitable. Vegetables should first be immersed in boiling water for 1 to 5 minutes to remove soil bacteria. The vegetables are placed in bottles and immersed in cold water which is slowly brought to the boil and boiled for $\frac{1}{2}$ –1½ hours or considerably less if a pressure cooker is used as the temperature is much higher.

Vegetables may be preserved with dry salt (33 lb of vegetables) or in 1–2 spoonfuls of salt to 1 pint. The vegetables and salt are layered in a tub and

pressed down with a tight fitting wooden cover.

Pickling in salt or acid liquor is suitable for many fruits and vegetables such as artichokes, beetroots, carrots, cauliflower, figs, onions, pears, capers and nasturtium seed. These are soaked in brine and then covered with spiced vinegar or even as with pickled pears may be cooked in it. Chutneys are grouped with pickles containing similar ingredients with an appreciable amount of sugar added and the mixture cooked to a mush. A mixture of cooked vegetables, spiced vinegar and sugar strained through a sieve produces a piquant sauce or relish.

Drying. Most fruits and vegetables can be dried at a temperature of about 130° F in 2–4 hours or when laid on trays and thinly sliced or cut in small pieces by the heat of the sun's rays. They require little attention beyond an occasional raking over.

Jams and jellies. Jams and jellies consist essentially of fruit and sugar. Stone fruit and others requiring long cooking to soften the skin before adding the sugar will also require water. To obtain a good set some acid content and the right consistency are essential. Most fruits contain acids, others such as cherries, strawberries, loganberries and blackberries benefit by the addition of lemon juice, tartaric or citric acid. The mixture thickens during cooking. If 1 teaspoonful of the cooled juice placed in 3 teaspoonfuls of methylated spirit, jellies readily, the fruit is ready for the addition of sugar. Some fruits—strawberries, blackberries, rhubarb and cherries—require mixing with more acid fruits—gooseberries, apples, citrus fruits, currants and raspberries or red-currant juice—for a good set to result. Usually 1 lb of sugar is mixed with 1 lb fruit where a gill of water is added; the sugar must be increased by 2–3 oz. in jellies the liquid is strained from the fruit after cooking, and we subsequently to the weight of the

and the whole boiled again for 5 to 20 minutes. It can be tested by cooling a little on a plate from time to time. The preserving jars should be heated, and small wax discs or circles of thin butter paper placed on the jam before it cools. When cold, sheets of gummed paper or parchment may be pasted or tied on as covers.

A preserving pan, preferably aluminium, which is easy to lift and is unaffected by fruit acids, and a wooden spoon, is the only equipment needed.

Fish In home curing, salt is rubbed in and the fish left in a cool, airy place. Next day a mixture of bay salt, brown sugar, and saltpetre is rubbed in, and the fish covered with common salt. Two days later it is turned and covered with fresh salt, which is then removed and the fish hung up to dry.

Eggs See EGGS, INDUSTRIAL HANDLING OF

CONSULT *Domestic Preservation of Fruit and Vegetables, No 21* (Ministry of Agriculture and Fisheries), *The Making of Jams and Jellies*, and *Preserves*, published by "Good Housekeeping")

Foods in Season

<i>Poultry and Game</i>	<i>In Season</i>
Blackcock	Oct-Dec
Capercaillie	Aug-March
Chickens	All the year (best July to Oct)
Ducklings	March-Sept
Ducks	Aug-March
Ducks (wild)	Aug-March
Fowls	All the year
Geese	Sept-Feb
Grouse	Aug-Dec
Guinea fowl	March-Aug
Hares	Sept-March
Landrail	Aug-Sept
Leveret	Aug-Feb
Ortolan	March-May
Partridges	Sept-March
Pheasants	Oct-Feb
Pigeons	All the year
Plovers	Oct-Feb
Ptarmigan	Sept-April
Quail	Sept-Feb
Rabbit	Sept-March
Snipe	Sept-Feb
Teal	Oct-Feb
Turkey	Sept-March
Venison	June-Jan
Widgeon	Oct-Feb
Woodcock	Sept-March

<i>Fruits</i>	<i>In Season</i>
Apples	All the year
Apricots	June-Sept
Bananas	All the year
Blackberries	Sept-Oct
Cherries	May-Aug
Cranberries	Nov-Jan
Currants	July-Sept
Damsons	Sept-Oct
Figs (green)	July-Sept
Gooseberries	July-Sept
Grapefruit	All the year
Grapes	All the year
Greengages	Aug-Sept
Lemons	All the year
Medlars	Oct-Jan
McJons	June-Nov
Nectarines	Sept-Oct
Oranges	All the year
Peaches	August-Oct
Pears	Sept-March
Pineapples	All the year
Plums	Aug-Oct
Pumpkins	Sept-Oct
Quinces	Sept-Oct
Raspberries	June-Sept
Rhubarb	Jan-May
Strawberries	June-Sept

<i>Fish</i>	<i>In Season</i>
Bloaters	Sept-April
Bream	All the year
Brill	All the year
Cockles	All the year
Cod	Nov-April
Conger eel	Sept-Nov
Crabs	March-Oct
Cray fish	All the year
Dab	Sept-April
Dory	All the year
Eels	May-March
Flounders	All the year
Haddock	Aug-Feb
Hake	May-Aug
Halibut	All the year
Herrings	April-Nov
Lobsters	All the year
Mackerel	April-Aug
Mussels	All the year
Oysters	Sept-April
Plaice	All the year
Prawns	All the year
Salmon	Feb-Aug
Scallops	Oct-March
Shrimps	All the year
Skate	Oct-April
Smelts	Oct-May
Soles	All the year
Sprats	Nov-March
Surgeon	April-Sept
Trout	Feb-Sept
Turbot	All the year
Whitebait	Feb-Sept
Whiting	All the year

<i>Vegetables</i>	<i>In Season</i>
Artichokes	
Globe	June-Oct
Jerusalem	Oct-June
Japanese	Dec-March
Asparagus	March-July



MAP OF GREAT BRITAIN DRAWN BEFORE AD 1400
By Claudius Ptolemaeus of Alexandria (From the original in the British Museum)

Vegetables	Season
Bean	
Broad	July-Aug
French	June-Oct
Runners	July-Oct
Beetroot	All the year
Broccoli	Oct-April
Brussels sprouts	Oct-March
Cabbage	All the year
Cabbage, red	Sept.-Dec
Cardoon	Jan. to June
Cauliflower	June-Sept
Celeriac	Jan. March
Celery	Sept. Feb
Chervil	All the year
Chicory	Jan. April
Endive	Nov. March
If it be not	All the year
Horseradish	Oct. June
Leeks	All the year
Lettuce	All the year
Mushrooms	All the year
Onion	All the year
Spanish	Oct-April
Spring	March-July
Parsnips	Sept. May
Peas	May-Sept
Potatoes	All the year
New	April-Sept
Savoy	Nov. March
Sweet	Feb. July
Shallot	July-Dec
Sorrel	March-July
Spinach	Nov. July
Tomatoes	All the year
Turnips	All the year
Vegetable marrow	July-Sept

Foodstuffs Purity of Various
Public Health Acts (qv) have made the local Medical Officer of Health and the local Food Inspector responsible for the purity of the food supply. Meat for instance is carefully inspected for any signs of disease. If any taint is found the meat must not be offered for sale. If any impurity is found by the housewife it should be reported at once to the Local Medical Officer of Health.

Adulterated Foods. Some unscrupulous vendors of foodstuffs introduce cheaper and sometimes useless ingredients to make up weight. For instance milk may have water added in order to increase its volume. Custard powders have been found to contain none of the cream milk and eggs suggested on the labels and so on. Public analysts have adopted standards which various food

times purposely misleading will protect the public. Any food can be analysed by a public analyst for half a guinea and cases of adulteration will be taken up by the local magistrates.

Fools Feast of, a mediæval Christian celebration and merry making probably a survival of the Saturnalia of Ancient Rome. In spite of the strong disapproval of bishops and councils these burlesques crept into the Christian Church. Merry making was particularly indulged in on the feast of St Stephen St John's Day and the Feast of the Holy Innocents. Originally performed without profanity in course of time the ceremony assumed a form of mockery and grotesqueness dancing talking drinking at the altar and obscene behaviour being part of the mock mass performed. The Feast of the Ass representing the flight of the Holy Family into Egypt (the most important celebrations of which were performed at Sens Beauvais and Rouen) was doubtless at first performed with reverence but later it degenerated into a series of ridiculous rites. Even as late as the 17th cent these feasts were celebrated in France.

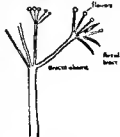
Fool's Parsley a slender plant of the family

Umbelliferae 1 ft high with dark green doubly pinnate leaves and terminal compound umbels of white flowers.

It is a common garden weed and in its young state

somewhat resembles parsley. An annual flowering in July and August the plant is poisonous and has disagreeable smell when bruised.

Foot, the part of the lower



Fool Parsley

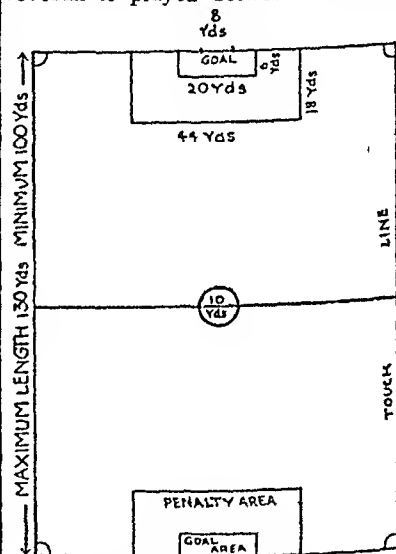
on which man and some other animals stand or walk. Its structure is essentially similar to that of the hand. There are seven tarsal bones, corresponding to the wrist, the astragalus, supporting the leg-bones, and the calcaneum, forming the heel, being the largest. The others are the scaphoid, cuboid, and 3 cuneiform bones. A row of 5 elongated metatarsal bones articulate in front with the phalanges, of which there are 14—3 in each of the four outer toes and 2 in the big toe. The sole of the foot is hollow, and in the middle the outer edge only should touch the ground in walking. The arch of the foot is supported by ligaments, when these weaken flat-foot (*q v*) results. See also CLUB-FOOT.

Foot, Isaac (b 1880), British politician (Liberal), entered Parliament in 1922, and was Secretary for Mines in the National Government, 1931–2. His son, DINGLE FOOT, was elected M.P. in 1931.

Foot-and-Mouth Disease, a disease of horned cattle, sheep, etc., caused by a virus and characterised by the appearance of vesicles on the mouth, tongue and elsewhere, and salivation and champing of the mouth. The disease is intensely contagious, and has an incubation period of 2–4 or 5 days. Any suspected outbreak must be at once notified, and, if confirmed, the slaughter of infected animals is compulsory, and all movement of cattle in the affected area stopped.

Football. Although various forms of a game involving the kicking of an inflated ball have been played from very early times, modern football, as an organised game with definite rules, dates only from the middle of the 19th cent. Three distinct codes are now recognised in Great Britain: *Association* ("Soccer"), *Rugby Union* ("Rugger"), and *Northern Union*. *American Football*, as played mainly in the USA and Canada, is an elaborate variation of the Rugby game. Eton, Harrow, and Winchester have their own codes,

which are played only at those schools. *Association football* is probably derived from a form of the game played at Cambridge in the first half of the 19th cent. A code of rules forbidding the use of the hands was drawn up in 1863, and officially adopted by the *Football Association*, the governing body of the game, which was formed in the same year, with 11 affiliated clubs. Association football is played between teams of



Plan of Association Football Field

11 a side, with a spherical inflated leather ball, 27–28 in in circumference, and c 14 oz in weight. The ground is c 120 yds long by 80 yds wide, having a goal at each end 8 yds wide, with a cross-bar 8 ft above the ground. The back of the goal is usually covered by a net. The usual duration of a game is 1½ hours, in 2 periods of 45 minutes each, with a 5-minute interval at "half-time." The team now comprises 5 forwards (centre, inside and outside right, and inside and outside left), 3 half-backs, 2 full-

backs and a goal keeper. The object is to propel the ball with the feet or head through the opponents goal. Only the goal keeper is allowed to touch the ball with his hands and that only within his own penalty area and he may not carry it more than 2 steps without bouncing it on the ground. A ball kicked over one of the side (or touch) lines is thrown in by one of the opposing side. When it crosses one of the back (or goal) lines it is kicked in by one of the defending side unless it has first touched one of the defenders in which case the attacking side is awarded a free kick from the corner flag (a corner kick). Any infringement of the rules may be penalised by a free kick awarded to the opposing side if the infringement takes place within the penalty area (see diagram) the kick is taken from the penalty mark 12 yds from the opponents goal which may be defended only by the goal keeper.

The game is controlled by a referee who has absolute jurisdiction over all

ball crossed the line. Unless there are 2 opponents between a player standing in his opponents half of the field and the opponents goal at any time when



Association Football. A goal for the ball in hand is 12 yds.

the ball is kicked by a member of his own side he is said to be *offside* and may not play the ball or interfere in any way with any member of the opposing side.

The Football Association Cup competition was inaugurated in 1871. The Cup Final which was originally played at Kennington Oval is now played annually at Wembley Stadium. Recent winners of the F.A. Cup have been 1978 Blackburn Rovers 1979 Bolton Wanderers 1980 Arsenal 1981 W. Bromwich Albion 1982 Newcastle United 1983 Everton. Aston Villa and Blackburn Rovers have each won the Cup on 6 occasions.

The Football League was founded in 1888 and now has 3 divisions the 3rd division containing a Northern and a Southern section. Every club plays home and away matches with every other member of its division and at the end of each season the leading 2 clubs of the 2nd and the leading club in each section of the 3rd division are promoted, replacing



Association Football. A goal for the ball in hand is 12 yds.

questions arising in the course of play and by 2 linesmen who when the ball is kicked into touch indicate by waving a flag the point at which the

THREE PROMINENT ASSOCIATION FOOTBALL PLAYERS



Alec Jackson (Chelsea)



W. James (West Ham)

1932 were Everton, in 1933, Arsenal. The first recognised international match was played between England and Scotland in 1872, between England and Wales in 1879, and between England and Ireland in 1882. The *Amateur Cup* competition was inaugurated in 1893.

The first match between *Oxford* and *Cambridge* was played in 1873. In 1932 Oxford had won 23 times, Cambridge, 22.

Association football has since the War attained wide popularity on the Continent, especially in Austria, Italy, and Spain.

Rugby Football started at Rugby School, and was firmly established all over the country by 1870. Originally there was no limit to the number of players (see *Tom Brown's Schooldays*, by T. Hughes, for an account of the game as played at Rugby in the early 19th cent). The present number of 15 a side was adopted in 1877, in which year the practice of deliberate "hacking" was also abolished.



"Dixie" Dean (Everton)

the bottom 2 clubs of the 1st and 2nd divisions. The League Champions in

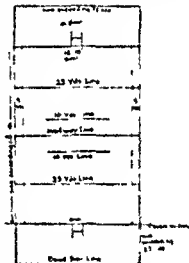
The English Rugby Union was formed in 1871 followed by the Scottish in 1873 the Welsh in 1890 and the Irish in 1881. Each union controls the game in its own country and international matches are regulated by the International Board established in 1849. The first international match between England and Scotland was played in 1871. The Ashes Cup was presented in 1879. The Calcutta Cup for annual competition between England and Scotland. England held the Cup 10 times and 193. Scotland in 1905, 1931 and 1933 and the 1930 competition was drawn. The first match between England and Ireland took place in 1870 and between England and Wales in 1849. Scotland has played Ireland since 1877 and Wales since 1893 and Ireland has played Wales since 1842. Rugby was taken to France at the opening of the 20th century and the first international match between England and France was played in 1906.

The County Championship was first organised in 1890. Gloucestershire was Champion County in 1907, 1931 and 1932. The first County match was played in 1837. In 1900, Oxford had won 28 matches, and Cambridge 23.

Among the Dominions New Zealand and South Africa have taken rugby with the greatest enthusiasm and visiting teams of All Blacks (from New Zealand) and Springboks (from South Africa) have proved extremely formidable opponents. The first New Zealand team (Maori) visited England in 1888. In 1905 a New Zealand team won 3 matches out of five, only 1 against Wales. The Springboks first appearance in 1906. A New South Wales (Australia) team in 1927 visited for the first time and Wales visited England and Scotland.

The game is played on a ground of approximately 110 yds long by 75 yds wide with 40 yds of touch on each side. The shape standard

in length circumference 30-31 in width circumference 25½-26 in weight 13½-14½ oz. The goals consist of 2 uprights of unlimited height 18 ft. 6 in apart with a cross-bar 10 ft from the ground. A goal is scored by kicking, the ball over the cross-bar between the uprights. The ball may be kicked or carried or thrown but must not be thrown forward. Any player is offside when in front of the line between it and the opponents goal. The object of



the game is to move the ball into the goal by kicking down the ground or by passing the ball behind the scrumming ground. When a try has been scored a player is at goal is taken from a scrum at the place where the ball was scored down. The scrumming line must remain behind their own goal line and the ball has been taken to pass over the line after which they may attempt to charge the ball down. A goal may also be scored

free-kick (*penalty goal*), or in course of play by means of a "drop-kick," i.e. if the player in possession of the ball drops it, and kicks it at the moment of impact with the ground. A goal from a try ("converted try") counts 5 points, an "unconverted try" 3 points, a "dropped goal" made in course of play 4 points, a "penalty goal," whether "placed" or "dropped," 3 points, and a goal kicked from a "mark," 3 points. The 15 players on a side usually comprise 8 *forwards*, 2 *half-backs*, 4 *three-quarters*, and a *full-back*, but this arrangement is not invariable.

A peculiar feature of the Rugby game is the *scrum* or *scrummage*, originally a mass of players trying by brute force to drive the ball through a similar mass of opponents. To-day a "scrum" is formed on the referee's order, usually after a forward pass, or other minor infringement. The opposing forwards "pack" down head to head, in 3, 2, 3 formation, while the ball is put into the scrum by the "scrum-half," between the two front rows. Each side then endeavours to "heel" the ball to the back row, and thence out to the scrum-half, who usually throws it straight out to the "fly" or "stand-off" half. The latter tries to "draw" the opposing defence, and then passes to one of his "three-quarter" line. Alternatively the forwards may "wheel" in a body, taking the ball on with them at their feet, in what is called a "forward rush." A "loose scrum" or maul is formed when a player is "tackled" and brought down with the ball, when the forwards pack down round the ball, and endeavour either to "heel" or "wheel," as described above. If the ball is kicked or thrown over the "touch line," it is thrown in by a member of the opposing side, the forwards of both teams lining up in a double row at right angles to the line. If the ball crosses the goal-line and is "touched down" by one of the defending side, it is returned to play from the 25-yd line. After a

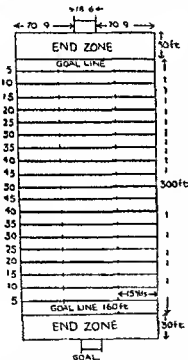
goal or try has been scored the ball is "kicked off" from the centre of the field, as at the beginning of the game. The "kick-off" must not cross the touch-line before touching one of the opposing side.

The duties of *referee* and *linesmen* are the same as in Association football. A club game consists of two 35-minute periods, with a 5-minute interval. International matches are two 40-minute periods.

The *Northern Union* broke away from the Rugby Union in 1895 on the question of "professionalism," against which the Rugby Union has always resolutely set its face, and a number of clubs in the N of England combined to form the *Rugby League* on the lines of the Football League, under Northern Union rules. The Rugby League cup final is now played annually at Wembley. Leeds won in 1932, and Huddersfield in 1933. In the Northern Union game there are only 13 players a side, usually 6 forwards, the other positions being the same as in Rugby Union. The Northern Union game tends to be faster than the Rugby Union, as there is more "open" passing, and the "maul," the "forward rush," and the "line out from touch" have been eliminated. A try scores 3 points, and a "converted" try 5, other goals, whether "penalty" or "dropped," score 2.

American Football in its present form dates from c 1870. It is played on a field 330 × 160 ft, marked out in 5 yd squares, with strips 5 ft wide at both edges of the field. The goals are as in English Rugby and the ball of similar shape and material. The teams consist of 11 men a side, 7 *linemen*, or forwards (including a "centre," 2 "guards," 2 "tackles," and 2 "ends"), 2 *half-backs*, a *quarter-back*, and a *full-back*. A *touchdown* ("try") scores 5 points, a *converted try* 6, and a "goal from the field," whether "placed" or "dropped," 4. A "touchdown" behind their own line by the defending side is called a *safety*, and scores 2 to the attacking side.

Padded armour and helmets are worn and substitutes are allowed for injured players. Forward passing is allowed and a player running with the ball may be protected by interference. No other players run with him in order to block off would be tacklers. Tackles must be made above



the knee. A *scrimmage* consists of the 7 linemen lining up opposite each other at short distances. The ball is placed on the ground and *snapped* back by the centre to his quarter or full back. A *scrimmage* is held when the ball goes into touch or a player is tackled with the ball. The side in possession of the ball must make at least 10 yds. in 3 successive

attempts or lose possession. The quarter back acts as Captain on the field and before the snap back calls out a code signal to indicate the type of play which is to be next employed. The game is played mainly at the Universities and an enormous amount of public attention is attracted by the inter University matches.

Foot-candle, see LIGHTING ARTIFICIAL PHOTOMETRY

Foraminifera, a group of the Protozoa (q.v.) in which the animalcules generally resemble amoebae in simplicity of structure but frequently exhibit two alternating phases amoeba-like and flagellate in their life-history. Usually they have a shell which may be composed of sand grains or may be horny, calcareous or even siliceous. From an orifice or orifices in this shell protrude long generally branching and interlacing pseudopodia used for the entanglement of food particles.

Foraminifera occur in fresh or salt water either creeping in the mud at the bottom or floating at various depths. The chambers of the shell may be arranged in many different ways. In one of the best known existing forms *Globigerina* the chalk-forming organism the chambers are globose and generally arranged in an irregular but more or less conical spiral suggesting a snail's shell. This organism lives in countless millions in the surface waters of the ocean and the shells of dead individuals are continually sinking in showers to the bottom where mixed with the skeletons of other bottom living *Foraminifera* they form the *Globigerina* ooze a fine chalky mud which in process of time may be converted into chalk beds. At depths beyond c. 2500 fathoms the carbonate of lime is dissolved and then only a few *Foraminifera* with siliceous skeletons are found in deposits. The greater proportion of this siliceous ooze is made up of skeletons of other Protozoa the *Radiolaria* (q.v.). The *Globigerina*

India in the British Empire, and the Guinea Company which operated in Africa. There were also the Virginia Company, the Plymouth Company and the Hudson's Bay Company carrying on trade with American regions. The last-named of these companies exists to-day as an ordinary company, though it no longer holds the monopolies of its original charter.

Rapid Expansion Foreign Trade expanded very rapidly in this period. Figures are not available for the 17th cent., but the growth throughout the 18th cent. continued to be rapid. The following table (as published by Clive Day in his *History of Commerce*) and the *U.S. Statistical Abstract of Foreign Companies*, shows the growth from the end of the 17th cent. to 1930.

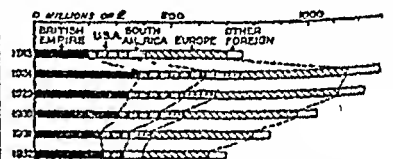
ENGLISH FOREIGN TRADE
(Millions of £)

Average of	Imports	Exports	Total
1689-1701	5.6	6.4	11.9
1749-55	8.2	12.2	20.4
1784-92	17.7	18.6	36.2
1802	31.1	41.4	72.8
1880	248	223	571
1890	356	263	619
1900	460	291	751
1910	575	430	1005
1920	1055	1710	2765
1930	1041	957	2001

Mercantilism The period of the chartered companies was the era of mercantilism (*qv*), when colonies were looked upon as a means of enriching the mother country. Settlements in far-off lands were made with a view to producing the raw materials needed at home, and as markets for European manufactures. The monopolies and privileges granted to the chartered companies were designed to further this goal. As trade and manufacturing developed, the great companies became more and more unpopular. By the end of the 17th cent. feeling became so strong that reforms were made, entrance fees were lowered, and some of the ex-

clusive privileges relaxed or abolished. By the early 19th cent. most of these companies were dissolved or their privileges and monopolies rendered ineffective. As can be seen from the table above, there followed a burst of expansion in British overseas trade, which increased by 8 times between 1802 and 1880.

Excess of Imports The most interesting change during this period of rapid expansion is that from a surplus of exports over imports, to an excess of imports over exports (see **BALANCE OF TRADE** and **BALANCE OF PAYMENTS**). Great Britain was selling services as well as merchandise to overseas communities, and was therefore able to afford to import more goods than she exported. This feature of British foreign trade has persisted to the present day. The chief services

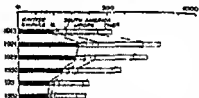


she now renders are shipping and the use of long-term capital for the development of new lands. British capital built railways, canals, roads, exploited mines. The largest item was railways.

United Kingdom's Place in World Trade The great trading countries before the World War were the United Kingdom, the United States, Germany, and France. The League of Nations has estimated that of the total of world exports for 1913, the United Kingdom accounted for 13.0 per cent., the USA 13.3 per cent., and Germany 13 per cent. Of total world imports, the United Kingdom took 16.8 per cent., USA 10 per cent., and Germany between 13 and 14 per cent. Canada, India, Holland, Italy, Belgium, Argentina, China, and Australia were other important countries in foreign trade. In the early

months of 1933 the United Kingdom regained her pre-War place as the largest exporter in the world.

Great Britain's Imports Though the War made considerable changes in the world's foreign trade the place of Great Britain as leading exporter being taken by the United States the nature of British trade changed little. Being the first country to mechanise manufacturing and produce large quantities of comparatively cheap wares the United Kingdom rapidly expanded her exports to all parts of the world during the 19th cent. More and more especially after the repeal of the Corn Laws in 1846 which removed the protective tariff on foreign wheat this country grew to depend upon cheap agricultural products imported from N. and S. America, Australia and even from



British ports, showing distribution according to year.

Europe and turned her attention to industrial products for export. By 1913 the United Kingdom depended on imports for 56 per cent of the total foodstuffs consumed by her 45½ millions of people. This tendency increased after the War and it was estimated that she imported 60.7 per cent of her foodstuffs in 1924. Whereas 80 per cent of the wheat consumed was imported in 1913, 85 per cent was imported in 1924, 48 per cent of meat consumed came from abroad in 1913 and 55 per cent in 1924, 87 per cent of the butter used was imported in 1913 and 89 per cent in 1924.

There is now a strong demand that British agriculture shall be restored by means of tariffs to limit imports of foreign foodstuffs. The National

Government introduced a very slight limitation of some food imports by means of quotas.

Not only does the United Kingdom import more than half the food but a large part of the raw materials



Net British imports (including re-exports) classified according to commodities.

essential to her manufacturing industries. Some of these cannot be produced in Great Britain at all such as cotton and rubber but some such as tin and wool which were once staple exports of the country are now needed in large quantities from abroad. Nearly 90 per cent of the wool, 94 per cent of the wood and timber, 90 per cent of the tin, and even a 30 per cent of the iron ore used in British manufacture and construction are imported.

It is now urged that a larger proportion of many imports could be secured from the Dominions and Colonies by means of tariffs.

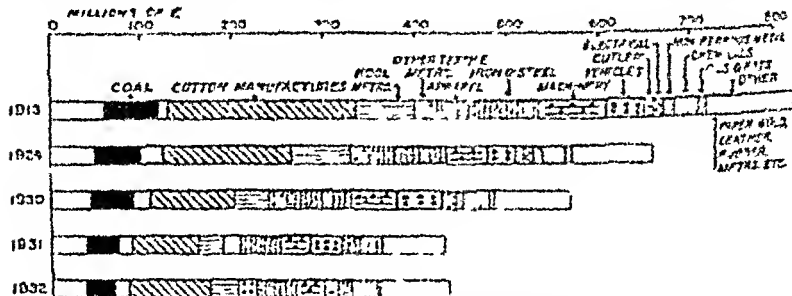
Empire Markets for Exports It is claimed that it would be more profitable to the British Empire to create



Net British imports (including re-exports) changes in volume measured by value (1929) prices.

larger markets for our exports in the Dominions and Colonies than to depend on markets in foreign countries which impose tariffs against us.

The British industrial structure produced being far greater than the was attuned to a great export trade, home consumption. About one-third the quantity of many commodities of the iron and steel produced, a



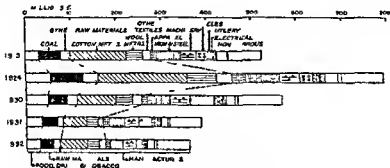
British exports Changes in volume measured by values at 1929 prices.

BRITISH EXPORTS (DOMESTIC)

Declared values

Millions of £

	1913	1924	1930	1931	1932
Food, Drink and Tobacco	57.9	56.9	45.2	53.5	52.5
Raw Materials	66.2	106.2	63.4	47.1	43.6
Coal	50.7	72.1	15.7	31.7	31.6
Other	15.5	34.1	18.1	12.4	12.0
Manufactures	412.5	618.8	440.0	290.6	276.6
Cotton yarns and manufactures	126.5	199.2	87.6	66.6	12.5
Wool yarns and manufactures	33.7	67.8	36.9	25.1	24.0
Other textile yarns and manufactures	18.2	29.7	21.1	13.9	14.2
Total textile yarns and manufactures	180.4	296.7	145.6	95.6	100.0
Apparel	21.0	30.0	19.5	14.0	11.5
Total textiles and apparel	201.4	326.7	165.4	109.6	111.5
Iron and steel manufactures	55.4	71.2	51.3	30.4	18.0
Cutlery, hardware, and tools	7.1	8.4	7.3	6.3	5.5
Machinery (including electrical)	33.6	11.8	47.0	33.0	29.5
Electrical goods and apparatus	5.1	10.6	11.9	7.4	5.4
Vehicles	21.5	20.7	51.0	20.4	20.7
Non ferrous metal manufactures	12.0	15.7	12.0	6.9	6.9
Total engineering and metals	138.0	180.8	180.5	122.4	66.4
Chemicals, drugs, dyes, etc	19.5	25.5	21.9	17.0	17.4
Oils, fats, etc	4.4	8.0	7.5	6.3	5.1
Other manufactures	50	76.0	61.7	36.3	41.9
Total	625.3	801.0	670.8	389.1	365.1



British exports of domestic goods declared since

BRITISH EXPORTS (DOMESTIC)

CMA N VO LM S MEAS Y VAL ES Y 192 AV PRICES

Millions £

	1913	1924	1930	1931	1932
Food Drink & Tobacco	87	49	45	41	39
Raw Materials	63	6	64	52	49
Coal	63	62	40	36	33
Other	97	24	24	16	16
Manufactures	609	613	441	366	3
Cotton yarn & manufactures	201	14	28	0	21
Wool yarn & manufactures	68	6	37	29	31
Other yarns and manufactures	6	23	31	16	20
Total yarn and manufactures	275	215	240	117	136
Apparel	38	37	29	16	15
Total textiles and apparel	251	238	180	123	151
Iron and steel manufactures	66	59	61	39	37
Cutting handwoven goods	13	6	7	6	7
Machinery (including electrical)	62	45	47	37	29
Electrical goods and appliances	12	13	12	6	4
Vehicles	44	29	61	31	26
Non-ferrous metal manufactures	19	13	12	6	6
Total metal and engineering	214	164	181	117	109
Chemicals, drugs, dyes, etc.	29	1	2	18	20
Other manufactures	8	7	4	6	7
Total	924	643	611	623	499

quarter of the engineering products, half the ships built, more than half the wool textiles, and as much as four-fifths of the cotton manufactures of this country were marketed abroad, even after the War. If markets are not found for these products British workmen will be unemployed. The contraction in demand for some of Britain's chief exports (e.g. coal and wool products) together with increased industrialisation and higher tariffs in many of the most important pre-War markets for British goods, has caused constant unemployment since the War. The most important export cotton manufactures has been the hardest hit with a resulting curtailment in total exports. Hence the demand that the importation of Japanese cotton goods, at cut-throat prices, into India, E. Africa and other parts of the British Empire shall be drastically dealt with.

The figures shown on pp. 326-0 give British imports and exports in 1913, in 1921 and since 1930. The "declared value" figures are misleading because of the great price changes during the period covered. For this reason another set of figures and charts is given showing the values at 1930 average prices. This second set of figures gives a better idea of changes in the quantities of the different types of products bought and sold, and the effects on employment in the five great British industries can be imagined. More than half of total exports consist of coal, cotton manufactures, wool manufactures, iron and steel, and engineering products (machinery, railway carriages, motor-cars, ships, etc.).

These statistical tables show how the shrinkage in the exports of cotton manufactures, of iron and steel goods and coal, has pulled down total exports to a value well below that for 1913, and to quantities even more startlingly less than in the pre-War year. Though the "all other" item has held its pre-War value, it has not shown the expansion necessary to counteract the shrinkage in the

exports of the great basic industries. The diagonally downward dotted line on the import charts shows roughly the amount of various classes of imports. A much larger quantity of many of the food products could be produced at home. The remainder of the loss represents roughly manufactures which compete with home-produced goods. One of the most interesting features of the import charts is the very marked decrease in this section of British imports in 1932 (especially in textiles and clothing), which was the result of the new tariff coupled with the competitive advantage derived from the suspension of the gold standard and the consequent depreciation of sterling in the terms of gold-standard currencies.

The Direction of British Foreign Trade. There have been interesting changes in the direction of British trade since the War. The most important change has been in the tendency of this country to trade more with the British Empire and proportionally less with foreign countries. The tables referred to above show this change in a striking way. The year 1932 showed the most marked increase in the proportion of empire trade to the total, and it may be expected that under the influence of the Ottawa Agreements, the increasing tariffs in foreign countries, and the patriotism of the British purchaser of all kinds of goods, there will be still further increases in the future.

The principal markets for British exports, in the order of their importance in 1932, were India, 9.34 per cent, Irish Free State, 7.06 per cent; Australia, 5.48 per cent, followed by France, the U.S.A., Germany, and Holland. British imports come chiefly from the U.S.A., 11.0 per cent, Argentina, 7.23 per cent, Australia, 6.57 per cent, Canada, 6.14 per cent, and Denmark, 5.77 per cent, followed by New Zealand, India, and Germany. (Before 1932, Germany was the second largest importer into the U.K.)

The Re-export Trade. The United

Kingdom also uses a large business in trade brings money to British subjects importing products from overseas in the form of commissions and countries re-selling them and shipping, freights. The central post exporting them abroad again. This tion of London highly developed

EMPIRE SHARE OF BRITISH MARKET

TOTAL BRITISH IMPORTS

Millions ££

From	1913	1914	1929	1930	1931	1932
U.S.A.	141.7	241.2	196.0	183.3	104.0	83.7
Europe	311.6	311.4	436.8	411.2	373.3	364.4
S. America	69.6	11.9	123.6	97.0	6.8	3.3
Other Foreign	34.3	14.0	106.8	85.3	65	63.3
British Empire	131.5	28.9	328.8	334.0	24.4	49.1
Total	652	127.4	1,408	1,040	461.3	551

Percent of Total Imports

From	1913	1924	1929	1930	1931	1932
U.S.A.	18.43	14.63	16.05	14.70	13.09	11.90
Europe	47.81	31.4	35.5	39.23	42.67	33.73
S. America	9.00	9.31	1.04	8.89	8.89	10.00
Other Foreign	7.11	9.6	9.33	8.14	7.63	9.93
British Empire	4.87	3.1	24.80	29.12	24.73	33.43
Total	100	100	100	100	100	100

Excluding Irish Free State and British possessions in Europe

BRITISH EXPORTS

Millions ££

	1913	1924	1929	1930	1931	1932
U.S.A.	29.29	83.98	45.86	24.0	15.23	15.1
Europe	190.68	216.62	11.81	184.15	123.63	120.9
S. America	50.27	6.07	0.53	50.34	27.84	25.86
British Empire	195.31	335.69	324.45	245.94	170.97	163.84
China	14.85	0.33	11.03	8.87	8.8	7.9
Japan	14.52	2.9	13.43	8.23	8.19	8.75
Other	40.33	6.48	85.93	42.45	36.44	27.4
Total	535.8	800.8	799.1	535.78	390.43	365.13
Irish Free State	—	4.39	24.08	11.50	30.81	3.00
Total (without Irish Free State)	—	796.47	823.17	524.28	359.62	359.56

Percentage of Total Exports

	1913	1924	1929	1930	1931	1932
U.S.A.	9.89	8.4	6.35	9.03	4.6	4.14
Europe	34.33	30.9	14.26	33.26	34.21	33.13
S. America	9.89	3.0	0.12	8.82	4.0	6.18
British Empire	3.14	41.67	44.45	43.61	43.7	45.13
China	2.73	2.34	1.02	1.50	2.61	3.13
Japan	9.7	3.23	1.84	1.44	1.48	1.6
Other	7.69	7.42	7.41	4.1	6.79	7.52
TOTAL	100	100	100	100	100	100
	—	(8.90)	(4.95)	(8.04)	(8.2)	(7.06)

Excluding Irish Free State and other British possessions in Europe.

UNITED KINGDOM TRADE WITH PRINCIPAL CUSTOMERS

Thousands of £

IMPORTS

	1913		1921		1920		1930		1931		1932	
	%		%		%		%		%		%	
United States	18.43	111,652	18.88	211,190	16.67	195,980	15.33	153,497	12.07	104,009	11.90	83,672
Argentina	5.53	42,485	6.18	78,955	7.01	82,417	5.57	56,665	6.12	52,741	7.23	50,870
Denmark	1.10	23,830	3.83	18,901	1.78	56,178	5.40	51,118	5.12	46,696	5.77	40,555
Germany	10.46	80,411	2.89	35,888	5.85	68,818	6.52	55,190	7.15	54,153	4.32	30,410
France	5.03	46,363	5.21	66,678	1.81	56,549	1.91	19,267	4.76	40,922	2.71	19,023
Holland	3.07	23,578	3.34	12,735	3.60	42,372	3.95	39,524	1.09	35,198	3.13	22,001
Belgium	3.04	23,382	2.85	36,387	3.75	11,019	3.83	38,016	8.85	33,190	2.27	15,090
Russia	5.24	40,270	1.55	19,771	2.25	26,487	3.42	34,235	3.76	32,286	2.80	19,637
Japan	5.7	4,888	5.8	7,170	7.8	9,132	5.0	7,820	8.1	5,953	9.5	5,693
Total												
Foreign	75.13	577,210	59.79	889,566	73.99	861,023	71.54	739,945	71.27	613,836	51.58	451,118
Australia	1.95	36,065	4.62	59,022	4.73	55,648	4.61	45,419	5.31	45,679	6.57	46,132
New Zealand	2.64	20,338	3.58	46,964	4.05	17,727	1.18	14,899	4.39	37,775	5.33	37,485
Canada	3.97	30,488	5.16	65,000	3.95	45,410	3.81	38,140	3.81	31,841	6.14	43,146
India	5.30	18,120	5.17	78,873	5.34	62,815	5.10	51,044	4.25	35,711	4.50	32,715
S. Africa	1.60	12,301	1.41	18,026	2.07	21,309	2.02	20,312	1.52	13,120	2.21	15,630
Irish Free State	—	—	4.00	51,096	—	45,087	1.12	42,955	1.24	36,517	3.77	26,531
Other Empire	—	—	—	—	—	—	—	—	—	—	—	—
Total Empire	21.87	191,515	30.21	387,873	25.01	358,812	25.46	304,029	28.73	247,416	35.42	249,015
Total	100	768,735	100	1,277,439	100	1,220,765	100	1,043,975	100	861,253	100	703,133

EXPORTS

	1913		1921		1920		1930		1931		1932	
	%		%		%		%		%		%	
United States	5.58	29,295	6.74	53,842	6.57	45,558	5.35	28,705	4.40	17,101	4.14	15,098
Argentina	4.31	26,541	3.40	27,201	4.19	29,071	4.72	25,231	3.80	14,789	2.92	10,563
Denmark	1.10	5,792	1.72	13,799	1.54	10,670	1.91	10,219	2.22	8,534	2.70	9,860
Germany	7.74	40,677	5.32	42,587	5.33	36,967	5.00	26,899	4.73	18,113	3.99	11,581
France	5.51	28,933	5.21	41,748	4.57	31,663	5.51	29,690	5.79	22,537	5.06	18,450
Holland	2.94	15,429	3.15	25,222	3.15	21,818	3.52	18,800	3.52	13,685	3.32	12,108
Belgium	2.52	13,240	2.83	22,658	2.80	19,413	2.81	15,035	2.57	10,017	2.39	8,745
Russia	3.45	18,103	4.8	3,860	5.4	3,743	1.27	6,772	1.83	7,121	2.54	9,375
Japan	2.77	11,530	3.33	26,701	1.94	12,431	1.51	8,229	1.58	6,165	1.57	5,733
Total												
Foreign	62.82	320,912	58.33	463,364	58.99	401,898	60.99	322,110	56.15	218,557	54.67	199,605
Australia	5.56	31,471	7.59	69,760	7.82	54,235	5.91	31,578	3.74	14,554	5.18	20,025
New Zealand	2.05	10,838	2.54	20,333	3.00	21,303	3.33	17,867	2.88	11,195	2.81	10,350
Canada	4.53	23,795	3.50	28,172	5.05	25,005	5.39	29,128	5.28	20,560	4.49	16,409
India	13.38	70,273	11.31	90,577	11.28	78,227	9.88	52,941	8.30	32,304	9.34	34,091
S. Africa	4.23	22,184	3.78	30,270	4.69	32,536	4.94	25,462	5.61	21,519	4.96	18,109
Irish Free State	—	—	5.00	47,297	—	35,078	6.04	34,497	7.82	30,414	7.06	25,774
Other Empire	—	—	—	—	—	—	—	—	—	—	—	—
Total Empire	37.18	195,311	41.67	377,603	41.01	324,151	39.01	248,345	43.84	170,607	45.93	165,632
Total	100	525,253	100	909,967	100	729,349	100	570,755	100	389,164	100	365,137

banking services and connections of merchants all over the world made London the greatest entrepôt market of the world. Rubber, tea, metals, cocoa, cotton, wool and many other important products are sent to London and Liverpool for sale. Though this trade has decreased since the War because of the tendency to ship many of these products direct (especially tin and rubber from the East to the U.S.A. and cotton in the reverse direction) it still remains important. Another feature of the entrepôt trade is the making up in London of diverse orders from outposts in the Empire. These re-exported goods consist in manufactured products from all over the world.

Forest of Dean. *see* DEAN FOREST OF Forestry or the care of trees was developed very late in the cultural history of mankind. Early man cleared and destroyed woodland for wool for his dwellings and fields and pastureland for himself and his domesticated animals as colonists and nomadic tribes do to-day. In tropical and subtropical climates the land tends to revert naturally to forest but in temperate regions natural regeneration is usually indirectly prevented by man's activities. The forests of S. England were undoubtedly cleared very early. The fossil forests round the coast contain oak, beech, larch, pine and hazel trees together with the bones of aurochs, bear and short horned

BRITAIN 1933
Million £

	Food, Drink and Tobacco		Raw Materials		Manufactures		Total	
	Declared Value	Value at 1933 Prices	Declared Value	Value at 1933 Prices	Declared Value	Value at 1933 Prices	Declared Value	Value at 1933 Prices
1913	16	21	23	40	29	5	109	11
1924	30	29	6	55	34	29	141	113
1930	24	24	25	34	34	21	84	88
1931	30	23	26	3	17	22	64	55
1932	15	13	24	39	12	16	51	74

Foreland, North and South, chalk cliffs on the E. coast of Kent. The S. Foreland is N.E. of Dover and the N. Foreland N. of Broadstairs. Both are marked by lighthouses.

Foreshore, the shore and bed of the sea and of every bay, creek and tidal river as far up as the high tide mark. The foreshore belongs to the Crown.

Foresters, Ancient Order of, *see* FRIENDLY AND BENEFIT SOCIETIES.

Forest Fly a fly so-called from its abundance in the New Forest. It is an external parasite on horses and cattle; is flat in form, leathery in consistency and has legs specially adapted for clinging to the hair of its host. Although possessing wings it uses them but little. It is one of the so-called pupiparous flies giving birth to a single larva which quickly turns into a pupa.

ox Pine was completely eliminated from S. England in early days and only re-introduced in the 18th cent. the forests of non-coniferous trees were greatly reduced and the woodlands left only on tops of hills and on ground useless for other purposes or inaccessible. Agricultural practice grew in importance under the Romans and Saxons. Much land was taken into cultivation and enclosed to keep out the larger destructive animals. This in effect confined the deer and wild cattle to the remaining woodland where they to some extent hindered the natural regeneration of the woods.

Despite the wholesale enclosure of land for forest by the Crown there was no attempt to plant new woods or encourage the growth of trees until the reign of Edward IV. In 148 the

first Act concerned with arboriculture was passed, whereby it was made lawful for any landowner to enclose his woods for 7 years immediately after felling the trees, to allow the woods to regenerate naturally. Not till 1543 was the Statute of Woods published, which rendered compulsory the preservation of woods.

By Elizabeth's reign the demand for oak for shipbuilding forced the Government to give serious consideration to the care of timber, but Elizabeth herself gave away or rented much woodland, which was cleared for cultivation. After Charles II's reign the care of the forests was undertaken by the State, but the position grew slowly worse. The increase in trade resulting from railways and steamships brought the matter again into prominence, and towards the end of the 19th cent the question was seriously considered, Royal Commissions set up, and certain improvements introduced, including better management of forests and a scheme of replanting, an impetus was given to education in forestry.

During the World War large areas of British woodlands were again cleared, while planting operations were suspended, but during recent years there has been again a great and highly necessary increase in the attention given to re-forestation, and large areas are now being replanted under Government schemes. Under these schemes (1) land has been purchased and planted by H.M. Forestry Commission, e.g. the Forest of Dean, Thetford Chase, Ennerdale, etc., (2) grants have been given to landowners.

Native trees of the British Isles are mainly hardwoods (broad-leaved trees as distinct from conifers or needle-leaved trees), with the exception of the important timber-providing tree, the Scotch fir, now called by foresters the Scots pine (*Pinus sylvestris*), the unimportant and scarce yew, and the juniper, which is but a bush. Hardwoods, such as oak, ash, elm, chestnut, sycamore, beech, poplar, willow, etc., provide excellent wood for special

purposes, but wood from conifers grows quicker and is more suitable for general construction. Deal, for example, is the timber from *Pinus sylvestris*, which forms the major part of the imported timber. The Forestry Commission have therefore been carrying out an extensive scheme for planting softwoods, although attention is also being given to the provision of a later supply of hardwoods after the softwoods have been felled. As the soil and conditions vary so widely from district to district in the British Isles, experiments are being carried on to find the types of trees most suitable to each district. The native Scots pine is being cultivated extensively in Scotland, and larch, both European and Japanese, which provides an excellent timber, is also much grown. Douglas fir, a native of western N. America, is also being tried. Various sorts of spruce, notably Norway and Sitka, are also being grown experimentally.

There are many difficulties facing forestry in the British Isles. It is more difficult to market timber which varies so much and is available in such small quantities in divers parts of the country than to deal with large consignments of uniform quality arriving at a port. Moreover, these islands do not produce sufficient softwood timber to provide the railway companies with sleepers. Nevertheless, much is being done to utilise British softwood, especially in Scotland, for instance for fencing. For hardwoods there is a demand, but the cost of transporting individual trees from their scattered positions must be considered. Many hardwoods are therefore imported from abroad, notably from America, and tropical hardwoods for higher and finer uses such as furniture, veneer, etc.

The British Empire is rich in hardwoods, but poor in softwoods, compared with the European countries from which timber is imported.

For particulars of the forests of the world with maps, see Zon and Sparhawk, *Forest Resources of the World* (New York, 1923).

Forfar an ancient Scottish town and capital of Angus (q.v.) c 15 m N of Dundee. Jute making and bleaching are important industries. Several Scottish parliaments assembled here. The castle now destroyed was seized by Edward I and retaken by Robert Bruce. Pop 9600.

Forfarshire, see **ANGUS**.

Forfeiture, deprivation of some thing as punishment for some offence e.g. an attempt to evade payment of customs duties involves forfeiture of the goods. Until the *Forfeiture Act* 1870 conviction for a felony automatically involved forfeiture of the felon's property and still if the punishment ordered is 12 months imprisonment or more entails loss of public military or naval office, public pensions or superannuation allowances. See also **LANDLORD AND TENANT**, **MORTGAGE**.

Forgery the fraudulent making or altering of any document or writing with intent to deceive. In 1634 it

was made a capital crime. The *Forgery Act* 1861 consolidated the law and after enumerating the various kinds of forgery prescribed penalties ranging from imprisonment to penal servitude for life.

Forget-me-not, a name applied to a number of flowers including alkanet and speedwell. The true forget-me-not grows in streams and marshes and has a long rooting stem, bright green, roughish leaves and terminal leafless one-sided clusters of bright blue flowers with a yellow eye and a small white ray at the base of each lobe of the corolla. It belongs to the *Boraginaceae* family.

Forging a process of working metals by hammering and pressing while they are plastic through heat. It is peculiarly adapted to working pure iron which is plastic over a wide range of temperature and can be worked without injury to its qualities. Wrought iron is fibrous in nature, the metal containing a considerable quantity of slag which becomes liquid when



A 1000-ton Forging Press.

strongly heated, and in properly forged articles, the structure of the metal is maintained, whence the great reliability of forged parts as compared with those cast or cut is attained. In the latter, cracks may develop from invisible flaws in the original material, combined with excessive stress due to sharp changes of thickness. Iron for hand forging is utilised in the form of bars of various thickness, which are heated in the forge fire and shaped by hammers either directly, or with variously shaped tools (*fullers, flatters, swages, setts, punches*) held by long handles between the hammer and the work, most operations of hand forging thus requiring an assistant.

Pieces may be joined by *welding* (heating and hammering), but a weld must be very skilfully performed if it is to be as strong as the metal itself. *Swaging* is the drawing out of a part by a succession of blows. It is used widely for tungsten electric-lamp filaments. The metal is strongly heated and submitted to the action of a large number of hammers operating from all sides at once, acquiring a fibrous structure which allows it to be drawn into fine wire.

In *drop forging* a mould the shape of the article required is made in a pair of steel dies. The metal to be forged is prepared of a suitable size and shape, strongly heated, placed between the dies, and brought to shape by blows delivered upon the upper half of the die by a very heavy gravity or steam hammer. The uses of drop forging are continually increasing, it combines the valuable qualities of forged metal with the cheapness incident to mass production.

Formaldehyde (or *methyl aldehyde*), the simplest representative of the aldehydes (*qv*). Its formula is HCHO , and it is a colourless and very pungent gas which liquefies at -21°C and solidifies at -92°C . It is very soluble in water, and is always employed in the form of its aqueous solutions. Formaldehyde is manufactured on an industrial scale,

by passing the vapour of methyl alcohol mixed with air through a hot copper or platinum gauze. The alcohol is oxidised to formaldehyde, which is absorbed in water. Formaldehyde is widely employed as a disinfectant, for which purpose the aqueous solution (40 per cent) is used, often containing also c 15 per cent of methyl alcohol, such a liquid is known as formalin. Formaldehyde forms a solid polymeric modification known as paraform, which is obtained on the evaporation of an aqueous solution, if this solid is heated formaldehyde vapours are regenerated, and it is therefore used for disinfecting (funigating).

Formaldehyde has a strong preservative action, but its use for this purpose in foodstuffs is in most cases prohibited by law. Its action on a number of substances, such as glue or gelatine, is to render them insoluble in water, it is also used for the preservation of anatomical specimens. Probably the chief industrial use of formaldehyde is, however, in the manufacture of plastics (*qv*). It has the important power of forming insoluble condensation products with a large number of substances such as phenol, casein, etc. This industry has in recent years expanded very greatly, and now probably accounts for the largest proportion of the formaldehyde manufactured.

Formalin, a 40 per cent (by volume) aqueous solution of formaldehyde (*qv*), which in addition also usually contains c 15 per cent of methyl alcohol. It is used as a disinfectant and preservative.

Forma Pauperis, In (Lat "as a pauper"), term denoting the procedure laid down for persons to whom poverty would be a grave handicap in legal proceedings. To benefit from it, whether as plaintiff or defendant in a civil action, a poor person must obtain a certificate from the local committee appointed by the Law Society (*qv*) or provincial Law Society, certifying (1) that he is not worth more than £50 (£100 in special circumstances), ex-

cluding clothes and tools of trade
 (2) that his income is not above £2 per week (£4 in special circumstances)
 (3) that there are reasonable grounds for taking part in the proceedings
 (4) in matrimonial causes where the wife is the poor person in addition to (1) and (2) either that the husband and wife are not worth the amount specified in (1) and the joint income does not exceed that in (2) or that it is reasonable that the wife should be admitted as a poor person. Further more the name of a solicitor who has consented to conduct the proceedings must be submitted to the Society and he must sign the certificate.

The effect of poor persons procedure is that no court fees are payable nor unless the court orders otherwise shall the person in question be liable to pay costs to or receive them from any other party. He must not make any payment to the solicitor or counsel engaged though the committee may from time to time allow payments to be made by the poor person to the solicitor in respect of out-of-pocket expenses and in special circumstances the Court may order such sum as would have been allowed had the solicitor been retained by his client in the ordinary way but not exceeding one fourth the value recovered after deduction of all proper disbursements to be paid to the solicitor in respect of costs.

The procedure is applicable only to High Court proceedings to appeals where leave has been obtained and to county court proceedings where the action has been remitted to the County Court from the High Court. In criminal proceedings a person committed for trial on indictment is entitled to free legal aid in the preparation and conduct of his defence if a *defence certificate* is granted either by the justices on committing him or by the judge or chairman of the court before which he is tried. The certificate cannot be granted unless the prisoner's means are insufficient to enable him to obtain legal assistance and then it must be granted if the charge is one of

murder and may be granted if the charge is any other where having regard to all the circumstances of the case including the nature of the defence such a course is desirable in the interests of justice.

Formic Acid, a liquid with a pungent odour that solidifies at 9 C and boils at 101 C the lowest member of the fatty acids (*qv*). Its formula is HCOOH . Formic acid is found in nature in ants (whence the name) stinging nettles and in various parts of the animal body. It can be prepared by the action of sulphuric acid on sodium formate the latter is made by the action of carbon monoxide on caustic soda. The commercial acid appears in the form of a 90 per cent aqueous solution and is used in tanning and electroplating.

Formosa (Taiwan) an important Japanese island off the coast of Fukuken China separated from the mainland by a strait 95 m wide. A considerable mountain range including the peaks of Nutaka Yama (14 300 ft.) and Setau Zan (12 500 ft.) stretches from the S to the N and slopes gently W and more acutely E. The climate is hot and the rainfall plentiful. Vegetation is extremely luxuriant and timber is one of the island's principal natural resources. Agriculture is successfully carried on in the W and N regions and large crops of rice, tea, jute, sugar, fruit and beans are produced. The island is one of the principal world suppliers of camphor trees.

The mineral resources include gold, coal, copper and stone. Manufactures are not greatly developed with the exception of sugar refining, most goods being shipped in a raw state. Communications are in a backward state. The chief towns are Taikohu (196 000), Tainan, Keelung and Taichu. Government is administered by a Governor General and Governors of the five divisions and a considerable measure of self-government is permitted in local affairs. The inhabitants are Japanese, Chinese, Pepo-hwans, a

fairly civilised aboriginal people, and the Chin-lwan, a savage and intractable mountain tribe

Formosa, though long known to the Chinese, was not extensively settled by them. Efforts to establish trading stations were made by Spaniards and Portuguese in the 16th cent. Later Tainan and Tamsui became treaty ports, until the island was ceded to Japan in 1895. Area, 13,900 sq m, pop 4,592,500

Forres, an ancient royal Scottish town in Moray, on the Findhorn. The castle is mentioned more than once in Shakespeare's *Macbeth*. Sweno's stone is an ancient monolith, and the witch's stone is said to be the spot where Macbeth met the three sisters. There is a trade in flour, cattle, chemicals, and whisky. Pop 4170

Forrest, John, 1st Baron (1847-1918), Australian statesman and explorer. As surveyor for the W Australian Government, he led an expedition in 1869 in search of the lost explorer, Leichhardt, and later explored the greater part of the W Australian coastline and interior. He led development in W Australia, as first Premier, 1890-1901, opening up the mining districts and reforming land laws. Forrest later held portfolios in the Commonwealth Cabinet, and was acting Prime Minister of Australia in 1907, and Treasurer in the War Cabinet of 1917.

Forster, Edward Morgan (b 1879), novelist and critic, whose two best-known works are *Howard's End* (1910) and *A Passage to India* (1924). His production is small but carefully written, and his treatment of the reaction of personality upon conventions is masterly.

Forster, William Edward (1818-1886), British politician. He became Colonial Under-Secretary in 1865, and later joined the Liberal Government as Vice-President of the Council. His Elementary Education Bill of 1870 established free public education. In 1880 he was appointed Chief Secretary for Ireland by Gladstone. An oppo-

nent of Parnell and Home Rule, he attacked the Land League. He resigned on Parnell's release from prison, 1882.

Forster of Lepe, Henry William Baron (b 1806), British politician. He entered Parliament in 1892, became Commissioner for the Treasury, 1902-3, and from 1915 to 1919 was Financial Secretary to the War Office. From 1920 to 1925 he was Governor-General of Australia.

Fortescue, Sir John. (1) (1395?-1477?), writer on law, Chief Justice of the King's Bench (1442); author of *De laudibus legum Angliae*, written in exile, whither he accompanied Queen Margaret, wife of Henry VI.

(2) Fortescue, Hon Sir John (1859-1933), wrote the *History of the British Army* in 13 vols, and *Author and Curator* (1933). For some years Librarian of Windsor Castle.

Forth, a river and firth on the E coast of Scotland. The river rises NE of Ben Lomond and flows E, in a winding course to the firth. The main tributaries are the Allan, Devon, and Teith, and notable towns on its banks are Stirling, Cambuskenneth, Aberfoyle, and Alloa, up to which point the river is navigable. The firth is a deep inlet of the North Sea. Important ports on either shore include Lerth, Kirkcaldy, Bo'ness, Rosyth, and Portobello. There are several small islands, of which Inchkeith, Inverkeithing, and May are the largest. The area is well served by lighthouses.

Forth and Clyde Canal extends c 40 m between Grangemouth and Bowling on the Clyde. It connects the Firth of Forth with the Firth of Clyde, and forms a waterway across Scotland. It was completed in 1790 at a cost of about a quarter of a million pounds.

Forth Bridge, a famous cantilever railway bridge spanning the Firth of Forth, between S and N Queensferry, completed in 1890. The two main spans are each 1710 ft long. The top of the bridge is 361 and the railway track 157 ft above high-water level. The length is 1783 yds, or, with

approaches 2766 yds. The architects were Sir John Fowler and Sir Benjamin Baker. The bridge greatly shortens the distance by rail between Edinburgh and Perth.

Fortification, the strengthening of defensive positions against enemy attack with the object of protecting the defender and checking the attacker. It includes permanent peace time fortification, semi permanent and field fortification. Thorn hedges and earthworks used in primitive times were soon developed into strong walls which the Romans perfected adding look-out towers, ditches and fortified bridge-heads as a defence against catapults, battering rams and similar siege weapons.

Many of the ancient Greek cities such as Tiryns and Messene were elaborately fortified, others had low walls reaching to the sea in addition to their city walls e.g. Athens and Megara.

Fortification in the Middle Ages continued the Roman tradition, huge impregnable castles being built on hill tops and in other inaccessible places. These consisted of several rings of fortifications which could if necessary be abandoned successively to the besiegers—outworks, enceinte, wall, main wall and donjon.

With the introduction of artillery these high walled castles became out-of-date and in the 16th cent. smaller forts with earthen and timber bulwarks were introduced surrounded by deep ditches which could be covered by the fire of the defenders. The trace or plan of fortifications took up many indented and star-shaped forms. The art of fortification was developed with great brilliance between 1667 and 1698 by the French engineer Vauban who introduced the traverse to guard against enfilade fire. His ditches were 18 ft deep, the walls 18 ft thick, and the bastions 25 ft high.

By the time of the Napoleonic Wars the increasing power of artillery made it desirable for enemy guns to be

kept at a distance and several small forts were built inside an encircling wall. Later still rings of detached forts were raised at some distance from the central position to prevent the direct bombardment of the latter and after the Franco Russian War these became the normal form of fortification.

In the World War the use of masonry fortifications was almost completely abandoned since none could resist modern high explosives. Field fortification became of great importance. Trenchworks with low parapets were used against artillery fire and barbed wire entanglements, pits etc. against infantry attack. Almost solid concrete pill boxes for the protection of machine guns etc. were the only form of permanent fortification to prove successful. The 12 Liège forts fell in 9 days under fire from the German howitzers and the Namur forts were totally destroyed in 5.

In spite of this failure of permanent fortification under modern conditions the French in the post War period have fortified the whole length of their E and S frontiers abutting on Germany and Italy with detached forts. The rapid changes in scientific means of attack makes it unlikely however that any form of defence evolved in peace time would for long remain invulnerable.

Fort St. George, see MADRAS.

Fortuna, in classical mythology the goddess of luck.

Fortunatus, the hero of a legend that has appeared in many forms was the possessor of a purse that continually replenished itself and a cap in which he could travel where he wished. Dramatic versions of the story were written by Hans Sachs (1553) and by Thomas Dekker (1600).

Fort William, town in Inverness shire, Scotland on the NE of Loch Linnhe. The original fort built as Kilmallie by General Monk in the middle of the 17th cent. and renamed in honour of William III in 1690 was demolished in 1890. Near

by are the ruins of Inverlochy Castle. The town, which is dominated by Ben Nevis, the highest mountain in the British Isles (4406 ft), is a popular tourist centre, in the district are the Lochaber Hydro-Electric Works. Pop c 2000.

Forty-five, The, the second Jacobite Rebellion, in 1745, under Prince Charles Edward Stuart, the Young Pretender. After marching as far S as Derby, he was forced to retreat, and was finally defeated by the Duke of Cumberland at Culloden, April 16, 1746.

Forum, term used in ancient Rome to denote an open place in which meetings, markets, and law courts were held (whence the adjective forensic). The Roman forum corresponded to the Greek *Agora*.

Foscolo, Ugo (1778-1827), Italian man of letters, was for a time a soldier in Italy and France. Among his works are the tragedies *Ajace* (1811) and *Ricciarda*, and a translation into Italian of the *Sentimental Journey* (Sterne). He lived in England from 1816 to 1827, dying in London.

Fossa, the largest carnivorous mammal found in Madagascar. It is about the size of an otter, but is related to the civets and mongooses, is brown in colour, and has a long tail, short legs, teeth like a cat's, and lives mainly in trees, feeding on birds and small mammals.

Fosse Way, the name of a Roman road connecting Lincoln with Exeter. It passed through Leicester, crossed Watling Street at High Cross, a reputed 'centre of England,' and then ran SW via Chesterton, Cirencester, Bath, Ilchester, and Honiton. Length, 232 m.

Fossils are any remains or indications of previously living animals or plants preserved in the crust of the earth. Hence even a worm-burrow or a foot-imprint is a fossil. Formerly the term included inorganic objects and traces, such as rain-pits and ripple-marks, but these are now excluded from the definition.

The state of preservation of a

fossil varies according to the nature of the animal or plant, its habitat and mode of life, the conditions of burial, and the events subsequent to its entombment. Entire animals are seldom preserved. Complete hairy mammoths (*qv*) have, however, been found in the ice of the Glacial Period, and entire arthropods occur preserved in ironstone nodules of the Carboniferous and in Oligocene amber deposits of the Baltic.

Apart, however, from these instances, the fossils usually met with are hard skeletal parts like the spicules of sponges, the bones and teeth of vertebrates, the calcareous skeletons of corals and the shells of molluscs, brachiopods, and echinoderms. Fossils, however, are not solely preserved in water deposits. They are often found in caves buried under layers of stalagmites (*qv*), or even on the surface, especially in dry countries where the bones are protected from damp and other physical conditions likely to destroy them. Also the woody tissues of plants may be found as carbonised cellulose, and may form beds of peat, lignite, or coal.

For fossilisation, rapid and complete burial is essential. Hence, the remains of land animals have little chance of being preserved, but footprints, as in the Trias of England, may indicate their former existence.

Freshwater animals are more often preserved, and in freshwater strata the remains of land animals brought there by streams are often found. The action of streams is also sometimes responsible for the occurrence of land and freshwater forms in marine strata.

The type of deposit associated with the fossil, however, probably has the greatest effect on its preservation. Sands, being porous, are poor in fossil content, because percolating water will dissolve the fossils, and shells tend to become pitted owing to the greater hardness of the sand grains.

Clays, on the other hand, are impervious to water, and their soft, fine-grained character preserves de-

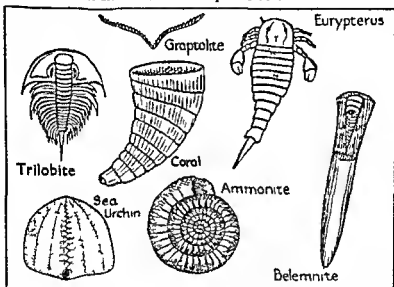
tails of ornamentation. But this very softness renders the beds liable to compression and the fossils unless enclosed in concretions (qv) are often flattened. Also the sulphides associated with clays often lead to the fossil being preserved in iron sulphide which completely disintegrates on exposure to the atmosphere.

After burial a fossil is liable to alteration by chemical and mechanical means. The least altered are natur-

ally those in the later geological formations but arthropods and graptolites may be found in ancient rocks almost unaltered. It is mostly percolating water with carbon dioxide in solution that alters them chemically especially in sandy beds but even if the whole fossil is removed the sand round it will often preserve the shape of the organism yielding a mould of the fossil which may show valuable details. In sandy and calcareous rocks empty shells may

slowly fill with silica and calcite respectively and a cast of the fossil is formed giving details of its internal structure. Such casts and moulds also occur in clay beds where the cast is often in iron pyrites and may show a beautiful metallic lustre as in the ammonites of the Lias (qv).

A more complete replacement is seen when the secondary mineral is deposited at the same time as the



Types of Fossil

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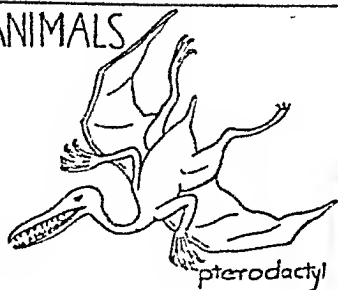
original material is removed. Then even microscopic detail may be preserved as in the silicification of plant tissues where the substance of the fossil is replaced molecule by molecule by the silica contained in percolating water. This slow and gradual process is known as *petrification*.

Derived fossils are those which are transported from a denuded bed and re-deposited along with a later fauna.

Fossils are important to geologists and biologists. To geologists they

PREHISTORIC ANIMALS

ichthyosaurus



pterodactyl

plesiosaurus

tyrannosaurus

triceratops

diplodocus

megatherium

stegosaurus

Hypothetical Restorations of Fossil Vertebrates

urnish evidence of the great duration of time during which physical conditions similar to those of the present day have existed.

Also the sudden appearance of comparatively highly organised animals like trilobites and brachiopods (pp. v) in the earliest rocks certainly known to be fossiliferous the Cambrian shows that probably for millions of years previously the sea must have been inhabited by plants and animals and that its condition must have been much as it is now.

The sudden disappearance of trilobites, eurypterines and graptolites (p. v) at the end of the Palæozoic era and the appearance and abundance of ammonites, belemnites and reptiles in the Mesozoic era shows the great lapse of time between these epochs. Similar evidence of great time-interval between the Mesozoic and Tertiary is supplied by the disappearance of the ammonites, belemnites and great reptiles at the close of the Mesozoic and by the appearance and abundance of large mammals in the Tertiary.

Fossils also supply evidence of the conditions under which strata were laid down—i.e. whether beds are freshwater, brackish or marine. Again they enable the geologist to correlate the age of beds by the identity or difference between their fossils. e.g. if a bed of Lias in Dorset has the same species of ammonite as a bed of Lias in Yorkshire the beds are assumed to be contemporaneous. Conversely if the species are different the beds are assumed to be of different ages.

In the case of land animals the identity between two fossils found in areas now separated by sea shows that the areas were continuous at the time the fossils lived and that submergence has taken place.

To the biologist fossils supply evidence of the gradual evolution of things from simpler to more complex forms.

In the case of plants although the

more perishable tissues have left fewer records the fossils show that more lowly organised groups like ferns, lycopods, horse-tails, and conifers found in the Palæozoic preceded dicotyledons which first appear in the American Cretaceous.

Again fossils demonstrate that the few species of existing nautilus, brachiopods and sea lilies are the surviving remnants of groups which formerly existed in profusion and in great variety of form. These are called persistent types. They have come down to us from Palæozoic times with very little change as also have scorpions and some other arthropods from the Carboniferous. Also fossils attest that there existed in the past many families and orders which although now wholly extinct, add greatly to our knowledge of the range in structural variations and habits within the classes. Examples are the great marine reptiles such as *Plesiosaurus* and *Ichthyosaurus* (pp. v) which took the place in the Mesozoic now occupied by Cetacea and the pterodactyls flying reptiles with wings something like a bat's. See also EVOLUTION.

Consult Davies A. Morley *Introduction to Palæontology* Swinerton H. H. *Outlines of Palæontology* Neavey L. *Stratigraphical Palæontology* von Zittel K. A. *Textbook of Palæontology*.

Fotheringhay historic village in Northamptonshire on the R. Nene where are the ruins of the castle in which Mary Queen of Scots was imprisoned and executed. Edward and Richard Plantagenet and Richard's wife and son are buried in St. Mary's Church (begun by Edmund of Langley) of which the nave only remains. Pop. c. 50.

Fouché, Joseph Duc d'Ortante (1813-1820) French politician. An enthusiastic Jacobin Fouché led the movement for Louis XVI's execution in the revolutionary Convention of 1793 and assisted in suppressing the revolts of La Vendée and Lyons. In

1794 he and Talien brought about Robespierre's downfall. He was Minister of Police 1799-1802 and 1804-10, when Napoleon dismissed him for usurping his authority in negotiations with Britain. He was reinstated when Napoleon returned to Paris before Waterloo, and, with an eye to future office, successfully plotted for the restoration of Louis XVIII. But his royalist enemies compelled him to resign office in 1816, and he died in exile.

Founder: (1) A certain kind of inflammation in the feet of animals (generally horses) caused by overwork, (2) a rheumatic affection in the chest of horses.

Foundling Hospitals, charitable institutions for the care of children abandoned by their parents, they were first founded to reduce the appalling toll of infanticide and exposure among illegitimate children, but with modern developments in social hygiene the problem has become comparatively unimportant. In the 7th and 8th cents., foundling hospitals were founded by the Church authorities, and their numbers rapidly increased in the Middle Ages, especially in France.

The Paris Foundling Hospital was founded by St. Vincent de Paul and Colbert in 1638, and incorporated in 1670. The Foundling Hospital of London was established by Captain Coram in 1739, illegitimate children being admitted only after personal examination of the mother, and on proof of the death or desertion of the father. In 1925 the Foundling Site in Bloomsbury was sold, but the greater part was saved by public subscription as a playground, and the Foundling Hospital was moved to Berkhamsted. Other waifs are received by Poor Law institutions, Dr Barnardo's Homes, etc.

A system parallel to that of abandoning illegitimate children to foundling hospitals was that of "baby-farming" (*q.v.*), the abuses of which were attacked by the Infant Life Protection Acts of 1872 and 1897.

Fountain: (1) (archaic and poetical)

Spring of water naturally issuing from the earth. (2) Artificial jet or jets of water rising or spouting from a pipe, structure, generally ornamental, containing one or more such jets, structure supplying drinking water in a public place. Ornamental fountains were known in ancient Mesopotamia, in the area of the Aegean civilisation, and in ancient Greece and Rome. Famous classical fountains include the Enneakrounos ("Nine Jets") in Athens, Hippocrene (sacred to the Muses) on Mount Helicon, and Pirene at Corinth.

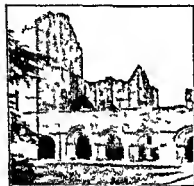
Roman fountains were both decorative and utilitarian. The former, frequently built on the exedra plan, were elaborate structures, one of the best known being the Exedra of Herodes Atticus at Olympia, Greece. Utilitarian fountains were the communal water-supply of a town or village, and so they remained until they were largely supplanted by wells. Mediaeval fountains followed the prevailing architectural fashions, a late-Gothic example being the 14th-cent. Schone Brunnen at Nuremberg.

Famous Renaissance and Baroque fountains include the Fonte Gaia of Jacopo della Quercia at Siena (1459), Bernini's fountain in the Piazza of St Peter's, the water-organ fountain at the Villa d'Este (17th cent.), Goujon's Fountain of the Innocents at Paris (16th cent.), and the fountains at Versailles (Louis XIV). The Fountain of the Lions, at the Alhambra, is an example of 14th-cent. Moorish work. Modern examples include the well-known fountains in Trafalgar Square, London, and the Buckingham Fountain at Chicago.

Fountain-pen, a pen which carries its own supply of ink which runs to the writing point as required from a reservoir in the holder. The self-filling type has a rubber reservoir for the ink, and is provided with means for compressing the reservoir whereby the latter sucks ink through the nib as pressure is released. Pens are also made with pistons in the reservoir. A

less-used type is the *stylographic* in which the writing point is formed by a fine tube a needle pressed by a light spring normally closes this from within the reservoir and when the writing point is pressed on the paper the needle is forced back and ink is able to flow. Fountain pen barrels are now made from plastic materials (qv) such as bakelite cellulose acetate ebonite and other substances, which can be given a highly decorative appearance.

Fountains Abbey a ruined Cistercian monastery founded c 1133 in the beautiful valley of the Skell 3 m SW



Fountains Abbey Cloister.

of Ripon Yorks. The nave and transepts were begun c 1133 and the abbey was gradually enlarged and improved until the Perpendicular tower was added in 1500-'6. The chapel of the Nine Altars is noteworthy.

Fouqué, Friedrich Heinrich Karl de la Motte Baron (1777-1843) German man of letters is remembered for his romance *Undine* (1811) whose contemporary vogue was very great.

Fouquet, Nicolas (1615-1680) a French financier. He became Superintendent of Finance in 1653 when Mazarin returned from exile but in 1661 he was found guilty of embezzlement and sentenced to life imprisonment. He died in Pignerol fortress.

Fouquier Tinville Antoine Quentin (1746-1793) French revolutionary. He practised law became a spy for the Parisian police and in 1793 was appointed Public Prosecutor to the Revolutionary Tribunal. During the Reign of Terror he exhibited great ruthlessness rarely failing to secure the death sentence. On the overthrow of Robespierre he was guillotined. Although relentless he was incorruptible and neither bribes nor entreaties could move him.

Fourdriner Machine *see* CELLULOSE. Four Horned Antelope a small antelope c 2 ft high found in the jungles of India its nearest ally being the Nilgai (qv) of the same country. It takes its name from the usual presence of four horns in the buck a feature in which it differs from all other antelopes.

Fournier François Charles Marie (17 -1837) French writer on socialism. He maintained that the full development of human nature was retarded by competition and individualism and stunted by restrictions. He advocated the division of society into sections, or *phalanxes* each of 1600 individuals living in *phalansteries* or communal buildings. Rich and poor were to live together private property being allowed but restrictions of every sort were to be abolished even marriage was to be substituted by a form of licence. His views are given in *Théorie des Quatre Monnaies* (1808) and in *Le Nouveau Monde Industriel* (1830). Various attempts at founding actual phalansteries in France and USA ended in failure.

Fournier Jean Baptiste Joseph (1768-1830) was born at Auxerre. He took part in the French Revolution but as a moderate he disagreed with the revolutionary policy and was several times imprisoned. When the Polytechnic school was opened (1795) he was appointed assistant professor. He was one of the savants who accompanied Napoleon to Egypt where he organised munition supplies. Besides

minor works, he produced a treatise on the theory of heat

Fourteen Points, The basis for a settlement of the World War suggested by President Wilson (*q v*) in an address to Congress during Jan 1918. Abortive negotiations for peace had been previously made. With the entry of America into the War, the situation changed. The U.S.A. Government had no desire to prolong the War, and began to discuss the foundations of a settlement. The address containing these fourteen points was framed largely on a report on the territorial settlement made by Colonel House, D. H. Miller, and Walter Lippmann, amongst others. Briefly the points were

- (1) Diplomacy—*e g* the peace settlement—to be open
- (2) Freedom of the seas in peace and war, except under International Agreements closing the seas or part thereof
- (3) Removal as far as possible of barriers to trade
- (4) Reduction of armaments as far as consistent with domestic order and safety
- (5) Adjustment of colonial questions, giving weight to the interests of the populations as well as of the Governments thereof
- (6) Evacuation of Russian territory
- (7) Evacuation of Belgium and complete restoration of her sovereignty
- (8) French territory, including Alsace and Lorraine, to be restored
- (9) Italian frontiers to be re-adjusted in accordance with the principle of nationality
- (10) The subject-races of Austria-Hungary to be given opportunities for development and autonomy
- (11) Rumania, Serbia, and Montenegro to be restored and the territorial integrity of the States in the Balkans to be guaranteed
- (12) Non-Turkish populations under Turkish rule to be given autonomy
- (13) The constitution of an independent Poland, with free access to the sea
- (14) A general League of Nations to

be formed to guarantee the settlement and the independence of all nations

Some, but by no means all, of the points were considered in the actual peace settlement

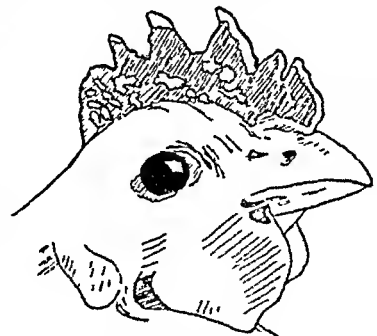
Fowey [*FOY*], a Cornish holiday resort situated at the mouth of the Looe River. There is a good harbour, and the local fisheries are valuable. In the Middle Ages Fowey was one of the largest Cornish ports, and fitted out many privateering expeditions against the French. Pop (1931) 2382

Fowl, see POULTRY

Fowler, John (1826–1864), English inventor of the steam-plough, drawn on a cable by a stationary engine, and other agricultural machines

Fowler's Solution, a solution of potassium arsenite, prepared by boiling together arsenic trioxide and potassium bicarbonate in water. The strength of Fowler's solution is equivalent to 1 per cent of arsenic trioxide. It is used medicinally as a mild tonic, especially for digestive disorders

Fowl-pox, the commonest contagious disease of the adult fowl, is known under a variety of names, such as bird-pox, chicken-pox, contagious epitheli-



Fowl pox Nodules

lioma, roup, and canker. The disease is caused by a virus, and is not communicated to humans, or domestic animals. Three forms are recognised

- (1) Wart-like nodules on the comb, wattles, and skin of head

(2) Adherent yellow cheesy membranes in the mouth.

(3) A watery or mucous discharge from eyes and nose

The disease is transmitted by direct contact infection usually entering through wounds. It is highly contagious and all infected birds should be killed and burnt and the remainder examined at frequent intervals. A protective vaccine can be injected into chickens 8 weeks or more old but does not give immediate immunity. The house should be thoroughly cleaned and disinfected with 3 per cent formaldehyde or 5 per cent solution of carbolic acid.

Fox, a large number of species of the dog family Canidae distinguished by the absence or very slight development of air-cells in the bones of the forehead. The species represented by the common English fox is the largest and most widely distributed of all being found nearly all over the N. hemisphere. It is distinguished by the white tag or tip to its tail and its black ears. It varies from red to black or greyish the palest and smallest specimens inhabiting the desert districts of the Punjab Persia N. Africa, etc. In colder districts of the N. the foxes are larger and carry a luxuriant winter coat which is a valuable fur the best skins coming from Canada where the principal colour variations are red black and silver tip (black with scattered white points) and the cross (half black and half red).

English foxes were imported into Australia to keep down the rabbits and their furs are now an important commercial asset. Within recent years Canadian foxes have been extensively bred in various countries on fox farms and the industry has proved lucrative.

Rivalling the common fox as a valuable fur bearer is the Arctic fox a smaller animal of which there are two varieties the blue which is the same colour all the year round and the

typical variety which is speckled in summer white in winter.

There are several other species smaller and of less commercial importance like the kit fox and grey fox of America and the Indian or Bengal fox and a small one in S. Africa. Apart from the N. American grey fox which extends to Colombia there are no true foxes in S. America the Argentine species called foxes being wild dogs.

The habits of foxes seem to be the same everywhere. They are nocturnal and lie up in burrows or natural crevices by day and feed upon small animals of all kinds as well as fruits. They do not hibernate and never hunt in packs although a pair may cunningly combine to capture prey. Only one litter is produced in a year.

Fox, Charles James (1749-1806) famous British statesman third son of Lord Holland was an inveterate gambler in his youth. He entered Parliament (1783) where he opposed the

Wilkes and Liberty campaign and in 1770 became junior Lord of the Admiralty. He resigned later to oppose the Royal Marriages Act thus incurring George III's disfavour. He rejoined the ministry later but was finally dismissed and joined Burke's Whig opposition. He opposed Lord North's policy against the American colonists and in 1782 became Foreign Secretary under Rockingham. The following year he formed a disastrous coalition with Lord North. After his cabinet's downfall (1784) he remained out of office for 2 years. As leader of the Whig opposition he denounced the hostilities carried on by Pitt against revolutionary France and advocated the removal of all religious disabilities and the abolition of the slave trade. On Pitt's death (1806) Grenville nominated him as Foreign Secretary. Shortly before his death he secured Parliamentary abolition of the slave trade. A brilliant orator and opposition leader Fox had little opportunity of revealing what constructive ability he possessed.

Fox, George (1644-1691) founder of

the Quakers, was born at Drayton, Leicestershire, the son of a weaver. He was silent and serious in childhood and youth.

He was early repelled by the clergy of his day, who were more interested in drinking contests than soul-saving. During a visit to London he became convinced that Christ Himself was the only minister that could save men's souls. His preaching in the countryside soon brought him many followers, who called themselves "the Society of Friends." Fox was often beaten



Geo. Fox, from a bronze in the library of the Society of Friends, London

almost to death for preaching the Gospel as he understood it, and for contemptuously referring to churches as "steeple-houses," but persecution naturally increased his following.

In 1650 he was brought to trial, during which his followers received the nick-name of "Quakers."

Whilst he was in prison the Commonwealth Army offered him a captaincy, but Fox declined the commission, in the name of "the virtue and power that takes away the occasion of all wars."

The movement grew intellectual men such as Wm Penn (qv) joined it. Despite merciless beatings, an attempt to drown him, and numerous imprisonments, some even without a trial, Fox continued on his mission. In those days of political upheaval, no man was safe, and at last Fox was suspected of plotting to restore the Stuart Dynasty. He was arrested, and cross-examined

by the Protector himself, but Cromwell was so impressed by Fox's simplicity and honesty that he set him free.

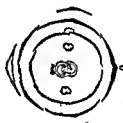
Fox's preaching took him far afield, he even had an adventurous journey across the Atlantic (1671-2). He spent his last years in organising the Society of Friends, and in preparing his *Journal* for the press. This work, though ill-written and in parts obscure, is still widely read.

Foxe, John (1516-1587), author of *The Book of Martyrs*. Born at Boston Lincs, he studied at Oxford and went abroad, where he devoted his time to writing a history of Christian persecution. He returned to England in 1559 and was ordained priest in 1560. His book on the Catholic persecution of reformers was published in 1563. It is marked by a hatred of Roman Catholicism, and historical inaccuracy. More to his credit is his plea for toleration which was much in advance of his day.

Foxglove Family, large family of plants (Scrophulariaceæ) containing nearly 2000 species, of which some are shrubs, but the greatest number are herbaceous, inhabiting all parts of the world, from the Arctic regions to the tropics. The flowers have a 4- or 5-lobed calyx which is persistent, an irregular corolla which is often two-lipped, two long and two short stamens, a two lobed stigma, and a two-celled capsule. The plants are often root parasites, obtaining some food from the roots of grasses or other plants. The leaves of the foxglove contain three valuable drugs, of which digitalin is the most used.

Among well-known wild plants are the purple foxglove, which grows in woods and hedgebanks, the yellow toadflax, which is common on waste land and railway banks, and is easily recognised by its spurred flowers shaped like snapdragons with a deep yellow stain on the pale lips, borne in dense spikes, and pale-green grasslike leaves, the ivy-leaved toadflax, with purple flowers, called "Mother of

Thousands because it spreads so rapidly over old walls the knotted and water figworts tall upstanding plants with square stems smooth leaves which give an unpleasant smell when bruised and loose panicles of purple flowers The cowslip red rattle and cocks comb (the latter a tiresome weed on cultivated land) are root parasites Eyebright is a dainty little flower with the habit of a minute shrub used in infusions to brighten the eyes and enlarge the pupils There are 16 species of speedwell the commonest having bright blue flowers Mullein grows on railway banks and roadsides and is a handsome plant with its large downy leaves and tall spikes of golden yellow flowers



Floral Diagram of
Scrophulariaceae

Many plants of the family are cultivated

Antirrhinum or snap dragon grows easily in any soil which is not too wet The seeds are sown in June to flower the following season Many

new kinds have been evolved during the last few years *Linarias* are dainty rock plants hardy annuals or perennials sown at the end of March in sandy soil *Mimulus* and *musc* are old favourites An ordinary damp soil in a sunny position suits them best *Nemesia* is a semi hardy annual from S Africa grown in a dwarf and an erect form with large bright-coloured flowers It should be grown in masses *Penstemon* are easily grown hardy perennials unrivalled for beds when massed In colour they are white yellow and all shades of red and a new dark blue variety has just reached the market

Schizanthus or butterfly flowers are semi hardy annuals sown in autumn or March in the greenhouse or

in the open air at the end of April The flowers are large on slender stalks with fringed and beautifully marked petals

Verbascum is a stately plant grown in shrubberies or the open border *Veronica* is a large genus including garden plants of many habits the purple flowered evergreen shrubs of cottage gardens which are sweet scented the scentless but larger flowered shrubs derived from them the herbaceous plants tiny rock plants and hardy aquatics

Foxhounds hounds derived from the old English breed of the bloodhound type crossed with the greyhound to blend speed with stamina scent and power of giving tongue More attention has been given to perfecting this breed than to any other breed of dog with the result that a type has been produced regarded as matchless for the purpose required Before the World War over 16 millions were spent annually in the United Kingdom in maintaining packs of foxhounds which have supplanted the old English stag hound and in many districts are preferred for otter hunting to the rough coated otter hound In colour they are black white and tan in various proportions The height should be 18-20 in The habit of artificially rounding the ears alters the hound like aspect of the head

Fox hunting see HUNTING

Foxtail Grass, (*Alopecurus*) has 6 English species of which 3 are common. Meadow foxtail grass is an abundant plant in meadows and one of the best meadow and pasture grasses being large with dense blunt spikes 2-3 in long flowering April-June The bent stemmed foxtail grass is a procumbent species with slender spikes and small spikelets common in moist meadows and a tiresome weed because it is of little food value but spreads rapidly and replaces better herbage The slender foxtail grass is a slender annual with long thin pointed spikes.

Fox terrier see TERRIERS.

Fracture, see FIRST AID

Fragonard, Jean Honoré (1732-1800), French painter, who studied under Chardin, but whose work bears no resemblance to his master's. It was the light and fanciful work of Bouclier, and later of Tiepolo, that Fragonard admired, and that most influenced his own style. He won the Prix de Rome in 1752, and worked in Italy from 1755 to 1761. Later he began producing for the French Court of Louis XV his graceful and charming paintings of nymphs and women, which made appropriate decorations for the royal apartments and for those of the dancers and courtesans of Paris and Versailles. In 1793 he left Paris and returned to Grasse, his birthplace. The stern classical taste of the revolution would not tolerate such luxurious and sometimes licentious tendencies in art, and Fragonard's popularity came to an end. When he returned to Paris some 10 years later, he remained forgotten and obscure until his death. To-day his paintings hang in the Louvre, and in most of the galleries of France, and a number of fine examples are in the Wallace collection, including *Le Chiffre d'Amour (Souvenir)* and *The Swing*.

"**Fram**," the three-masted schooner built in 1892 for Nansen's expedition to the Arctic, and used by Amundsen in the Antarctic in 1911. It has sailed the farthest N and farthest S of any ship.

Frampton, Sir George James (1860-1928), English sculptor, became an A.R.A. in 1894 and an R.A. in 1902. Frampton designed a number of medals and public monuments; he was knighted in 1906. He was the sculptor of the well-known *Peter Pan* statue in Kensington Gardens and of the *Edith Cavell* monument in St. Martin's Place, London.

Franc, a coin struck at various periods in French history, and now the standard unit of value in France. The first franc, of gold, was issued in 1360, and bore an impression of John II on horseback, hence its name of *franc à cheval*, in contrast to the later issue, the *franc à pied*, which showed Charles V

standing. This coin grew obsolete, but in the 16th cent. the word was applied to a *livre tournois* of 20 sols, the name being officially recognised in 1795, when the silver franc weighed 5 grammes. Before the World War the franc was equivalent to the lira, peseta, drachma, etc., at 25.22 to the pound sterling. Its value, with that of other allied currencies, was "pegged" during the War, but depreciated heavily in 1919-20, leaving the new currencies which had been based upon it (leu, lat, dinar, leva, etc.) to fluctuate separately. Selling of foreign credits raised its value from 120 to 67 to the pound in 1924, but a budget deficit and other difficulties caused a new slide in 1926 to a low level of nearly 250. Depreciation was stopped about the middle of the year, and a new stabilisation arranged at 124.21 to the pound. This was, in fact, somewhat below the real exchange value, and a great accumulation of gold in the Bank of France resulted. The action of Great Britain in going off the Gold Standard in Oct. 1931 caused new fluctuations in its exchange value to the pound, the rate in the summer of 1933 averaging 80-86.

France, European country bounded N by the English Channel, Belgium, Luxemburg, and Germany, S by Spain and the Mediterranean, E by Germany, Switzerland, and Italy, and W by the Atlantic. The coast is moderately broken, and provides many fine harbours, among which are Marseilles, Calais, Le Havre, Cherbourg, and Brest. There are several islands, including Belle Île, Nourmoutier, and Oléron.

Relief and River Systems. The general slope of the land is from SE to NW, it is in the main a huge plain, extending down the SW coast to the Pyrenees. In the SE and E are the Auvergne Mountains, the Cevennes, the Jura range, and the Vosges, forming a line from the E Pyrenees to the Meuse separated by the Rhône and other valleys from the Alps, of which large areas are in the extreme SE of the country, and in-

clude several peaks of between 3000 and 4000 ft. The chief rivers are the Loire which rises in the N. of the Cevennes and flows N. and then W. to the W. coast, the Rhône which rising in Switzerland flows through the Lake of Geneva S. into the Gulf of Lyons, the Garonne traversing the S.W. plain between the N.E. Pyrenees, the Meuse flowing also through Belgium and Holland, and the Seine which rises in the Côte d'Or Mountains and flows N. to the English Channel.

Climate. Similar in the N. to that of S.E. England, the climate shows greater extremes in the E. and on the S. coast is of the typical Mediterranean variety. On the whole the general climate is well suited to the predominant occupation of agriculture.

Flora and Fauna are for the most part similar to those found in England though the wild boar is still hunted in certain regions.

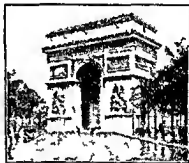
Agriculture. In spite of a steadily increasing urbanisation France remains predominantly an agricultural country, a large proportion of the farmers owning their land. In practically all necessities France is almost self-supporting: the crops of wheat, potatoes, barley and oats run into many thousand metric tons, and the production of sugar beet, fruit and green vegetables is extremely large. Since the World War the number of sheep kept has diminished with a consequent rise in frozen meat imports. Dairy produce, eggs and poultry are largely exported and could easily supply the entire population. The production of grapes makes France a great wine country though large quantities of foreign wine are imported for blending and home consumption. Cider is widely manufactured and brandies and liqueurs exported.

Great Britain is the chief importer of French goods and in addition to the commodities already mentioned receives flowers, seeds, bulbs, early vegetables, plants and nuts.

In general French agriculture has rapidly recovered the damage

done by the World War: the production of both flax and hemp has fallen off in bulk but silk, beetroot and timber, fruit and flowers have considerably increased.

Minerals and Industries. The chief French mineral resources are found in the N.E. and include coal, iron ore, bauxite, potash, lead, salt and antimony; the recovery of Alsace-Lorraine has provided large additional supplies of coal, oil and potash, but the country as a whole cannot be compared in mineral wealth with England, Germany or the United States. The chief manufactures other than metal goods are sugar, cotton, chemicals, silk, glass, clothing, wool

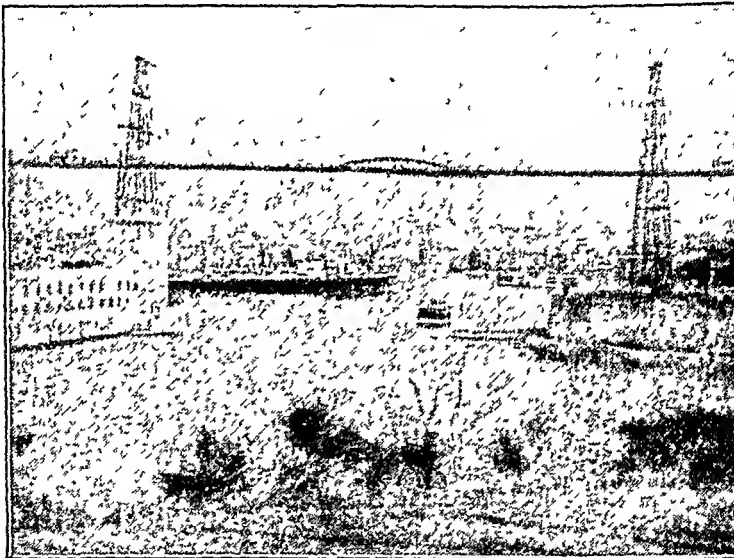


Arc de Triomphe, Paris.

len, perfumes and soaps and jewellery. After the World War France entered upon an era of great industrial advance partly owing to the new industries that the War had forced into being and partly because of the vital necessity of industrial rationalisation to re-establish the devastated areas. The general expansion of the automobile and aeronautical industries has benefited France, the excellence of whose machinery is widely recognised. A large amount of employment is given by the State, who owns large tracts of land and a number of factories. On the whole it is scarcely an exaggeration to say that French industry

has experienced since 1920 changes and advancement comparable with those of the English Industrial Revolution, and the considerable degree of self-support possible to an agricultural country has made the policy of high tariffs a successful one. There was a considerable slump during the great depression of 1930-33, but there appears to have been less unemployment and general hardship in France than in many other countries.

the more important; in size of population, however, the greatest are the capital (2,891,000), Marseilles (800,800), Lyons, Bordeaux, Lille, Toulouse, Nantes, Strasbourg and Le Havre. There are c. 20 with populations exceeding 100,000 and c. 40 with populations between 50,000 and 100,000. France possesses many of the most popular seaside resorts in Europe, including Dinard, Deauville, Dieppe, and Le Touquet-Paris Plage.



Old Part of Harbour, Marseilles

In conclusion, the large fishing industry should be noted. More than 140,000 people are employed, and the annual value of the products is over 1000 million francs.

The chief French imports, which are supplied by Germany, the U.S.A., Great Britain and Belgium, in that order, are coal, machinery, petroleum, cereals, wine, wool, and raw cotton.

Towns There are so many towns in France which are well known for their historical, financial, or cultural eminence that it is difficult to select

on the English Channel, Biarritz, the Bay of Biscay, and Cannes, Menton (Mentone), and many other places on the French Riviera. The chief naval port is Toulon.

Religion, Education, Culture. In 1905, when the Church was established from the State, there had been no official religion, though the population is predominantly Roman Catholic. There are about a million Protestants. Education is everywhere of a high standard, there are many types of school—primary, second

and superior. A council of 52 members in collaboration with a Minister is responsible for the organisation of the whole system. There are a number of adult technical and other special schools and the country has long been famous for its art and music schools. There are 17 universities the chief being Paris, Bordeaux, Montpellier, Grenoble, Lyons, Nancy, Strasbourg and Lille. The oldest is the University of Paris which dates from the 11th cent. French culture ranks with Italian as one of the oldest and greatest in Europe. Separate articles deal with the literature and art but apart from these the country has been a home of refinement, luxury and taste from very early times and Paris and other cities are still reckoned among the world's cultural centres.

Government. Since the débâcle of 1870 France has been a Republic. The government is administered by a President elected for 7 years by the Senate and the Chamber of Deputies and by these two houses of which the Deputies (613 members) are elected for 4 years by manhood suffrage while of the Senators (314 members) a third are renewed every 3 years so that the whole is renewed every 9 years. The latter must be citizens of more than 40 years of age; they are elected indirectly by municipal officials, deputies and others. There are also the Cabinet and the Conseil d'Etat which was established by Napoleon I to decide questions of administration which may be put by the Government. The President selects the Ministry, concludes treaties, appoints to all military and civil posts and can be arraigned only for high treason.

Local government is carried on through 90 departments each with a Prefect and Prefecture council. The departments are subdivided into communes directed by a mayor and a municipal council elected by universal suffrage. The arrondissement contains several communes its duty being to apportion the amount of direct taxation to each.

Communications. France is well provided with roads, railways and canals and is also taking a leading place in commercial aviation. There are the usual postal and telegraphic services. There is a thriving shipping trade the mercantile marine possessing a gross tonnage of nearly 3½ million tons.

The area of the country is 547 660 sq. m. pop. (1931) 41 83 000.

Early History. Gallic unity dates from the conquest of Julius Caesar (58-50 B.C.). Before that event Transalpine Gaul was settled mainly by hostile tribal communities. After 50 B.C. the inhabitants became rapidly latinised and in the great days of the Empire Transalpine Gaul was one of its most thriving provinces. But with the decline of Roman power Gaul was ravaged by neighbouring tribes and in the 5th cent. fell completely under the power of the Visigoths, Burgundians and Franks. In A.D. 481 Clovis, king of the Salian Franks, became supreme power in the N. Both Clovis and his successors comprising the Merovingian dynasty set about the subjugation of the neighbouring tribes of W. Germany and secured the support of the Church by adopting Christianity. The kingly power however was gradually weakening and finally passed into the hands of the former Mayor of the Palace, Pepin d'Héristal, and after him into those of Charles Martel and Pepin le Bref, the latter becoming in 751 king in name. The accession of Pepin infused new life into the monarchy which was continued by his son Charlemagne who was crowned Emperor of the West in 800 and who ruled at his death most of what is now Germany, France, a large part of Italy and Spain from the E. Pyrenees to the Ebro. His successors however failed to maintain the advance his genius had achieved and in 843 the Carolingian Empire was divided between his three grandsons. Internal wars desolated the land and foreign encroachments threatened on every side. The nobles

and various governors, free from constraint through the weakness of the later Carolingians, pursued their individual schemes of local aggrandisement and historic feudalism arose in this distressful period, almost reducing the half-developed State to the chaos from which Rome had rescued it. The power of the vassals surpassed that of the crown, and on the death of Louis V, the Carolingian dynasty was replaced by that of Hugh, Count of Paris, whose son, Hugh Capet, was crowned king in 987. The Capets (*qv*) were regarded only as first among equals, and their authority was not even absolute in the Île de France, their family domain. Until the 12th cent. their one achievement was to secure the regular succession to a vague overlordship in their family.

The Growth of the Monarchy The monarchical advance began on a modest scale in the reign of Louis VI (1108-37). His successes were chiefly confined to the royal domain, but he bequeathed a solid basis of strength from which his descendants extended their more ambitious schemes. Philip Augustus (1180-1223) began the long duel with the English Angevins who held half France, a contest leading to the Hundred Years' War (*qv*). Louis IX, Philip the Fair, and the early Valois continued the work of reuniting France. Supported by the rising commercial middle class, the monarchy defied the separatist instincts of feudalism, Papal interference, and the ambitions of the English kings. From the time of Philip Augustus can be traced the rise of that centralised administration which has persisted in its essentials throughout later French history. The institutional development of mediæval France culminated in the summoning of the States-General by Philip IV in 1302. The Valois were handicapped by their early reverses in the Hundred Years' War, but despite the republican revolt of Etienne Marcel (1356-8), the monarchy maintained its hold. The battle of Agincourt (1415) was

followed in 1420 by the Treaty of Troyes, which gave the crown of France to Henry V of England, who had married the daughter of Charles VI (1380-1422). When both Henry and Charles died in 1422 Henry's son, Henry VI was, in Paris itself, proclaimed king of France. France, however, was saved by Joan of Arc (*qv*), who freed Orleans in 1429 and caused Charles VII (1422-61) to be crowned king of France at Rheims the same year. By 1453 the English had been driven from France.

The Decline of the Valois The later Valois showed none of the sagacity of their predecessors. Reckless entanglement in schemes of aggrandisement involved France in a long and exhausting war with Spain. The nobility, under cover of the religious changes of the Reformation, once more embarked on separatist schemes, and the conclusion of peace with Spain (1559) was closely followed by the outbreak of the Religious Wars which distracted the country for the rest of the century.

The Bourbon Monarchy In 1589 the succession of Henry of Navarre, the last of the Valois and the author of the Edict of Nantes, allayed these religious wars, although his conversion to Roman Catholicism disappointed his own party. By degrees, however, he secured religious toleration, allowed his minister Sully to carry out a scheme of retrenchment which enabled the country to recover from the exhaustion of her wars, curbed the power of the nobility, and began a series of administrative reforms which were cut short in 1610 by his assassination by a religious maniac. Two ecclesiastics, the Cardinals Richelieu and Mazarin, consummated Henry's main task and curbed once and for all the turbulent aristocracy. His grandson, Louis XIV (1643-1715), succeeding to a united and powerful kingdom already acclaimed the first military power in Europe, ruled for seventy-two years as the most powerful sovereign in

Europe Under him the political and social system known as the Ancien Régime reached its highest point. At the close of his reign however the oppressive war taxes, the prodigality of the court and the clergy, the absolutism and religious intolerance of the aged king neutralised the work of Henry IV and the economic reforms of his own able minister Colbert leaving as heritage to his great grandson and heir Louis XV (1715-1775) a country whose foundations were unstable.

The End of the Monarchy Although the French kings and their ministers had built up a highly organised political structure it had many flaws. The monarchy rested on the support of the middle class. Political accident had prevented the growth of representative institutions and the fiscal incompetence of the French Government had given rise to grievances among its principal supporters which could not be voiced through any properly constituted organ. These grievances were responsible for the 17th-cent. rising called the First Fronde. The strain upon the hopelessly antiquated and corrupt system of taxation was increased to breaking point by the wars of Louis XIV and his successors and the crisis could only be solved by the Revolution which broke out in 1789 (see FRENCH REVOLUTION).

Modern France The Revolution did not lead immediately to democratic government but to Napoleon's military absolutism under which however administrative and legal reforms were effected. The restored Bourbons tried to govern as constitutional monarchs but the reactionary rule of Charles X provoked a revolution in 1830 and led to the liberal bourgeois monarchy of Louis Philippe which failed to comprehend the changing social conditions of the 19th cent. A large proletariat existed without political influence and the middle class was committed to the current individualist commercial policy. In 1848 France was convulsed by a social

revolution which was only terminated by a revival of the Bonapartist Empire. The Second Empire with a rule of complete absolutism failed utterly to eradicate the evils of the bureaucratic system which were again flourishing and its foreign policy was ultimately disastrous. After the German victory in 1870-1 a fourth revolution led to the establishment of the present Republican Government under the Constitution of 1870 which has endured with minor changes to the present time.

France Anatole (Jacques-Anatole Thibault) (1844-1924) French writer who published his first work in 1879 was literary critic of *Le Temps* from 1867. Lucidity, wit and delicacy of expression characterise France's work. His irony is as pungent as that of Voltaire. He was a cynic but the unforgettable characters he created—Jérôme Coignard, Jacques Tournebrot, M. Bergeret to name but three—show as nothing else could do the full depths of his sympathy and understanding. Among his best known works are *The Crime of Sylvestre Bonnard* (1891), *Thais* (1890), *Mother of Pearl* (1893), *The Opinions of Jérôme Coignard* (1893), *The Bell of St. Claire* (1895), *M. Bergeret at Paris* (1901), *Pen and Island* (1908) and *The Gods are Aghast* (1911). Anatole France's works have been translated into English.

France Ille de see ÎLE DE FRANCE
Francesco Piero della (c. 1416-1495) Italian painter also known as Piero del Franceschi was born at Borgo San Sepolcro and belonged to the Umbrian school. In his life time he was as renowned a mathematician as he was a painter and late in life he produced a book on perspective and one on the five regular solids. His mathematical interests and studies were of great advantage in his art, solidity of form and depth of perspective being two of his greatest qualities. His most celebrated works, his frescoes in the Church of St. Francis in Arezzo are among the finest ex-

amples of Italian art. His portraits of the Duke of Urbino, Federigo de Montefeltro, and his wife, Battista Sforza, in the Uffizi are splendid examples of portraiture. Another well-known, though earlier, painting is his *Sigismundo Malatesta Kneeling, before his Patron Saint*, at Rimini. The three specimens in the National Gallery, London, including the early *Baptism of Christ*, worth noting for the purity of colour of the flesh tints, and the delightful *Nativity*, reveal though

to Spain in the peace treaties, and taken again by France in 1674.

Franchise, *see* ELECTIONS, PARLIAMENT

Francin (c 1450-1517), Italian artist, whose real name was Francesco Raibolini. Francia was one of the finest painters of the Bolognese school, and was noted also as a goldsmith, an engraver of dies for medals, a niello-worker, and a type-founder. The *Madonna and Child with an Angel* in the National Gallery, London, his earliest-known painting, is a fine example of his work. He was a friend and admirer of Raphael, who, in his turn, praised Francia's work highly, particularly for the beauty of his Madonnas. His work is always well conceived and finely executed.

Francis II (1768-1835), last Holy Roman Emperor and first Emperor of Austria, succeeded his father, Leopold II, in 1792, and abandoned his Roman title when the Confederation of the Rhine was formed in 1806. Assisted by Metternich, he established a centralised Government, and preserved his Austrian empire against the onslaughts of Napoleon, who married his daughter (1810).

Francis I (1494-1547), King of France, made an unsuccessful bid for the imperial crown against his rival, the Emperor Charles V of Spain. He had acquired Milan in 1515, but failing to secure England's support at the Field of the Cloth of Gold, was forced to cede Burgundy to the Emperor (1520). He at first tolerated, but later persecuted, the Reformers. He was renowned for his love of art and chivalry. Francis was a patron of Renaissance art and learning. He founded the Collège de France.

Francis II (1544-1560), King of France, married Mary Stuart, later Queen of Scots (1558). He died a year after his accession.

Francis II (1836-1894), King of Naples and Sicily (1859-61), lost Sicily (1860) to Garibaldi, the revolutionary Italian leader. He retired into exile (1861), and Naples was united to Italy under King Victor Emmanuel I.



Portrait of an Unknown Lady, by Franceschi

less strikingly than the Arezzo frescoes, his finely planned composition, his simplified three-dimensional form, and his beautiful landscape.

Franche-Comté, former French province covering parts of the modern departments of Saône, Doubs, and Jura. For several centuries it was a part of Burgundy, and as such was ruled by a number of princes, but reverted by marriage to the Spanish Crown. It was taken by the French in the Thirty Years' War, returned

Francis, Sir Philip (140-1818) British politician. He was born in Dublin, and entered the Civil Service as clerk at the War Office. In India he was a member of the council of Bengal & quarrelled with Warren Hastings with whom he fought a pistol duel in 173. He was M.P. for Yarmouth 1790 and 1791. He helped to impeach Warren Hastings and supported Wilberforce in his attack on the slave trade. He founded the Society of Friends of the People in 1793 and was made K.C.B. in 1806. He is the supposed author of *The Letters of Junius* (q.v.) though this is not an established fact.

Franciscans, a religious order of mendicant friars called after their founder St. Francis of Assisi (q.v.). St. Francis gathered to his life of poverty a few disciples whom he formed into a community obtaining confirmation of their rules from Pope Innocent III in 1210. The rule was solemnly ratified in 1223. After the death of St. Francis the order split into a strict section (Observantines) and a milder section (Conventuals). Other groups broke away, one of the most important being the Capuchins (q.v.). Except Capuchins and Conventuals they all united in 1897 under the name of the Order of Friars Minor.

Francis Ferdinand (1863-1914) Archduke of Austria, nephew of the Emperor Francis Joseph, became heir to the Austrian throne on the death of the Crown Prince Rudolph in 1889. He contracted a morganatic marriage with Countess Sophia Chotek in 1900. It was his ambition to strengthen the Central Government at the expense of the Greater Serbia movement in the Slav provinces. His murder by Serbians at Sarajevo in June 1914 led to the Austrian ultimatum against Serbia and subsequently to the World War.

Francis Joseph I (1830-1916) Emperor of Austria and King of Hungary succeeded his uncle Ferdinand I in 1848. During the early years of his reign a centralised bureaucracy was estab-

lished. In 1860 Austria lost Lombardy to the Italian and later Venetia. After the disastrous war with Prussia (1866) the emperor abandoned ambitions towards ascendancy in Germany and accepted constitutional rule within his own dominions. By agreement with the Magyars he became King of Hungary (1867) and in 1867 and 1868 renewed the Triple Alliance with Germany. The tragic deaths of his brother Maximilian of his son Rudolph and of the Empress Elizabeth occurred between the years 1867 and 1894. In 1907 Francis granted universal suffrage in Austria and from this time delegated his powers to his ministers and to his nephew the Archduke Francis Ferdinand whose murder in 1914 precipitated the World War.

Francis of Assisi, St. (1181-1226) medieval mystic and founder of the



Church and Tomb of St. Francis, Assisi.

Franciscan Order. The son of a wealthy Assisi merchant, he spent his early years in pleasure. An illness following his return from his imprisonment at Perugia—he had been captured in battle—made him dissatisfied with his way of life. He began to devote himself to works of charity. Meeting a leper one day he passed on, owing to his horror of this disease, but returned, gave the leper all his money, and kissed his hand. He devoted his life to serving lepers and beggars but disinherited by his father for fear he should give all the family wealth away, he took to a life of poverty, spending his time preaching. (After

ing disciples he obtained sanction from Pope Innocent III in 1210 for his order of preaching friars (see FRANCISCANS). After a vision in 1224 he is said to have found his body marked with the stigmata of Christ crucified, the marks of the nails on the hands and feet. He was canonised two years after his death. His character is marked by his devotion to "Lady Poverty," and by his joy and delight in nature, expressed in his *Canticles to the Sun*.

Francis of Sales, Saint (1567-1622), Bishop of Geneva (1602), best known as the author of *A Treatise on the Love of God* and *An Introduction to the Devout Life*. He was closely associated with St. Jane Frances de Chantal (qv) in founding the Order of the Visitation.

Franck, César Auguste (1822-1890), greatest French modern composer, was born at Liège, and studied at the Paris Conservatoire. He was organist at St. Clotilde for 30 years, during which time he composed much of his magnificent organ music. Franck's influence on younger French composers was very great, and he numbered among his pupils d'Indy, Duparc, and Chaussan. Apart from his organ music and his beautiful oratorio, *Les Béatitudes*, Franck's best-known works are his *D Minor Symphony* (1880), *Symphonic Variations for Piano and Orchestra* (1885), *Violin Sonata in A* (1886) and *Les Djinns* (1884), besides such songs as *La Procession* and *Paris Angelicus*.

Franco-Austrian War, The, fought in 1859 between France and Austria over the question of Italian unity. The failure of 1848 showed that Italian unity could be achieved only by defeat of Austria, as the plains of W. Italy were under the rule of the Habsburgs. The Kingdom of Piedmont and Sardinia had aided the cause of Italian unity in the '48 revolution. Under King Victor Emmanuel and his Prime Minister, Cavour, this state became the leader of the movement for unity. The aim of Cavour was to

unite Italy under the rule of Victor Emmanuel. By aiding England and France in the Crimean War he hoped to win their assistance in defeating Austria. Napoleon III promised assistance if Cavour could find a reasonable pretext for war, and in return France was to have Savoy and Nice. These terms were put down in a secret treaty in 1858. Austria provided the pretext herself by sending an ultimatum to Piedmont requiring disarmament and invading that country in 1859. There were spontaneous risings in Italy, and the French marched into Lombardy to fulfil their promise to Cavour.

The French, with Piedmontese assistance, defeated the Austrians in two battles—Magenta on Jan. 4, 1858, and Solferino on June 24. At Villafranca Napoleon III concluded an armistice with the Austrians. Lombardy was to be handed over to Savoy, but the rulers of many Italian States, such as Tuscany, were to return, and an Italian Confederation was to be formed under the presidency of the Pope. This settlement was rejected by the Italian people themselves. The Central and N. States decided for unity under the rule of Victor Emmanuel. This was carried out in 1860, and Napoleon was given Nice and Savoy to gain his adherence to the new provisions. The same year saw the completion of Italian unity, save for Rome and the adjacent territory (see ITALIAN UNITY).

Franconia, ancient German duchy of S. of Saxony and Thuringia, originally inhabited by the E. Franks. It gradually lost its identity, and became merged into surrounding States, portions of the territory now form the Bavarian divisions of Upper, Middle and Lower Franconia.

Franco-Prussian War (1870-1), one of the most important wars of the 19th cent. Bismarck's attempt to unite Germany, partially successful in the formation of the N. German Confederation, had aroused the fear and distrust of the French people.

The actual conflict came about over the candidature of Leopold a member of the Hohenzollern family for the throne of Spain. This candidature supported by Bismarck without the knowledge of the King of Prussia the head of the house of Hohenzollern would if successful have resulted in considerable political and commercial advantages for Prussia. France showed definitely that if it were persisted in war would result. Prince Leopold withdrew his claim and the French Government tried to get guarantees from the King of Prussia that it would not be renewed. These were refused and the French Ambassador was told that the affair was closed by Leopold's withdrawal but Bismarck published an edited version of the King's dispatch in which it appeared that the King refused to see the French Ambassador because of the nature of the guarantees demanded. In France this was considered an insult and a cause for war and war was declared by France in 1870.

In Aug 1870 the French General MacMahon was defeated at Wörth and Alsace lay open to the German Army. Bazaine was defeated in Lorraine at Spicheren. These military disasters were followed by a political one the overthrow of the Ollivier Ministry. This had the sequel of giving the greatest influence to the Empress Eugénie and led to the fatal policy of trying to keep the seat of war away from Paris at all costs. The surrender of MacMahon and the French Army and the capture of the Emperor Napoleon III at Sedan was a crushing blow to France.

The Empire was overthrown as a provisional Government was formed. Paris under a revolutionary Government the Commune (qv) held out against the Germans for some months in spite of famine. Outside Paris Gambetta tried to raise the provinces. The French gained a victory at Coulmiers but the surrender of Bazaine at Metz crushed all hope of driving the enemy out of France.

Peace was concluded in 1871. Alsace and Lorraine were ceded to Germany and a huge indemnity was paid. On Jan 18 1871 the German Empire was proclaimed and William I of Prussia was proclaimed German Emperor the ceremony taking place in the Hall of Mirrors of Versailles where 48 years later defeated Germany signed the Treaty of Versailles.

Franc-tireurs irregular troops armed with rifles but not wearing uniform and usually not subject to military discipline. The term was first applied to the franc-tireurs of the Franco-Prussian War. They were usually shot when caught by the German army.

Frankalmoin, see **TENURE**.

Frankau Gilbert (b 1894) British author. He entered business and travelled round the world from 1901 to 1914 enlisted and was on active service in France from 1915 to Feb 1918 when he was invalided from the Service. His works include *One of Us* (1912) *The Guns* (1916) *The City of Fear* (1917) *The Judgment of Valhalla* (1918) *One of Them and I* (1919) *Cigar Mechaal* (1919) *The Seeds of Enchantment* (1921) *My Maids and Mustard pot* (1923) *Life and Erica* (1925) *My Unsentimental Journey* (1926) *Dance Little Centiman* (1929) *Martin Make Believe* (1930) *Peter Jackson and Other* (1931) *Christopher Strong and His Women and Masters* (1932).

Frankenstein, see **SHELLEY** **MARY WOLLSTONECRAFT**.

Frankfort, Treaty of, the treaty signed on May 10 1871 by Germany (Bismarck) and France (Thiers) after the surrender of Paris. It provided for the cession of Alsace and part of Lorraine and the payment of an indemnity of £ 600 millions to Germany.

Frankfurt-on Main, German commercial and banking town the birthplace of Goethe on the R Main in Hesse-Nassau. It is at the head of the Rhine navigation. Large industries have grown up including machinery printing clothing chemicals and brewing and a large trade in agriculture.

cultural produce is carried on. Notable public buildings are the cathedral (9th cent.), Liebfrauenkirche (14th cent.), Römer, Saalhof, which possesses an excellent picture gallery, and the Royal Institute, a famous medical research centre. Many Holy Roman Emperors were crowned here, and for several centuries until the union of Germany it was one of the four free cities. Pop 551,000.

Frankincense, gum resin obtained from trees of the genus *Boswellia*, used in the making of incense, and in ancient times medicinally. It was one of the gifts brought to the infant Jesus by the Three Wise Men.

Franking, the right of sending letters free of charge. It was claimed, for letters both sent and received, by the House of Commons in 1600, and fully legalised in 1704, when all members of both Houses were allowed to send 10 and receive 15 letters a day gratis. The privilege was withdrawn on the institution of penny postage in 1840. It is now used only by Government Departments. Franking in the United States was first allowed in 1776, and extended to nearly all officials and those in public service. Though abolished in 1873, it was gradually reintroduced, and is now widespread. The word is also applied to the stamping of postal packets by machinery instead of adhesive stamps. See also NATIONAL HEALTH INSURANCE.

Frankland, Sir Edward (1826-1899), was born in Lancashire, and educated in London, Marburg, and Giessen. He was Professor of Chemistry at Queen's College, St Bartholomew's Hospital, the Royal Institution, the Royal College of Chemistry, and the Kensington Normal School of Science. He published works on organic chemistry, coal-gas, town drainage, and climate.

Franklin, Benjamin (1706-1790), American statesman, philosopher, and author. He began life in Philadelphia as a painter, visited England (1724) and on his return became publisher of *The New England Courant*, *The Pennsylvania Gazette*, and *Poor Richard's*

Almanack. His business prospered, and in 1737 he became Postmaster at Philadelphia, organised the first circulating library and the first fire insurance company in the U.S.A., and founded an academy (1749), which later became the University of Pennsylvania. During this period Franklin carried out a series of electrical experiments. He was a member of the Philadelphia Assembly (1751-64), and joint Controller of the Colonial Postal Service. He was also agent in England for the American colonies during this period, and following his return from England (1762) opposed Britain's claim to tax her colonies without granting them representation. On the outbreak of the War of Independence (1775) he became a leading organiser for the American Government, and took part in the Continental Congress in Philadelphia. He visited France (1776), where, by the alliance of 1778, he secured funds and military assistance against England. His genius was universally recognised, and he exerted a profound influence on the radical French philosophers of his time. Before returning to America (1785) he concluded commercial treaties with Sweden and Prussia. During his last years he presided over the Supreme Executive Council of Pennsylvania, assisted in drawing up the Federal Constitution (1787), and led the movement in Congress for the abolition of slavery. Franklin's versatile genius is displayed in his many books and pamphlets on philosophy, science, politics, and economics.

Franklin, Sir John (1786-1847), British rear-admiral and explorer. He commanded an expedition which explored the Canadian coast overland from Hudson Bay to the Arctic Sea (1819-22), and along the Alaskan coast (1826). In 1845 he set out, in command of *Erebus* and *Terror*, in an attempt to discover the N.W. Passage to the Pacific. After many search parties had been sent out, McClintock ascertained in 1859 that Franklin and his party had perished in the

Arctic after discovering the N.W. Passage though they had not traversed it.

Franks, a federation of Teutonic tribes during the 3rd cent. A.D. comprising the Salian Franks and other lesser tribes. They were defeated by the Roman Emperor (A.D. 350) but under Clovis c. 480 rebelled and became independent once more. Clovis extended the territory of the confederacy adopted Christianity and founded a dynasty of kings the Merovingians succeeded by the Carolingian dynasty whose most famous scion was Charlemagne.

Franz Josef Land, group of barren islands in the Arctic ocean N. of Novaya Zemlya. Trappers occasionally winter here and sea and bear pelts may be obtained. The islands were discovered by Julius Payer in 1872 and explored by Leigh Smith 1881-2. They were further explored and surveyed by the Northcliffe Jackson expedition 1895-6. Area c. 20,000 sq. m.

Frascati, Italian residential town in the Rome province c. 18 mi. S.E. of Rome. It dates from the 9th cent. The Young Pretender died here 10p c. 11,000.

Fraser, Claud Lovat (1890-1911), English artist born in London who decorated and illustrated a number of books and broadsheets. After the World War he became interested in the theatre. His best known work is the stage settings and costumes which he designed for *The Beggar's Opera* and *As You Like It* both in 1910.

Fraser River, one of the most important rivers in Canada, length c. 740 m. Rising in the Rockies in two streams not far from Mount Columbia it joins and flows roughly N.W. until at the head of the Cariboo Mountains it runs due S. falling into a valley and turning W. to empty into the Strait of Georgia near Vancouver. Its chief tributary is the Thompson which joins it at the beginning of the valley and farther back the Quesnel and the Chilcotin.

At the head of the Cariboo gold is found, rushes have taken place there. Only the first 100 m. of the river are navigable.

Fraud, a wilful misrepresentation of facts either by conduct, false assertion or such suppression of part of the truth as makes the rest positively false with the result that the innocent party acts upon it and suffers harm. The only intent necessary is that plaintiff should act upon the statement. Fraud gives rise to an action for damages and in the case of a contract permits the plaintiff to rescind the contract. A statement is wilfully false if the defendant does not genuinely believe in its truth. To be actionable it need not even be wilful if there is a contractual relation between plaintiff and defendant involving the duty to use care in the making of statements e.g. architect and employer or a fiduciary relation ship e.g. trustee and beneficiary, company promoter and the public in the event of negligent false statements contained in a company prospectus or where there is a statutory duty to give correct information. But a representation as to the credit of a third person is not actionable unless made in writing and in order that that person may obtain credit. Fraud is also an element in many crimes e.g. obtaining by false pretences, embezzlement (qv) etc. See also **INJURIOUS FALSEHOOD**, **PASSING OFF**.

Fraser, Sir James George, O.M. (b. 1854), Scots anthropologist and writer is the author of *The Golden Bough* (1890-1915), 12 vols., highly important volumes on comparative religion, myths and folklore. Among his many other works are *Totemism and Exogamy* (1910), *Folk-Lore in the Old Testament* (1918) and his monumental translation and edition of *Panvanias* (ed. 1912).

Frederick, name of three Holy Roman Emperors.

FREDERICK I. (c. 1173-1190) see **BARBAROSSA**.

FREDERICK II. (1194-1250) became

King of Sicily in 1198, and in 1214 secured the title of emperor against his rival, Otto IV. He founded Naples University (1224), and in 1228 he led a Crusade. He captured Jerusalem, and on his return defeated the papal forces, which had invaded his Italian dominions. He established absolute rule in Sicily, where he mainly lived in the midst of an orientalised Court.

FREDERICK III (1415-1493) became King of Germany (as Frederick IV) in 1440, and by pledging the adherence of Germany to the papacy secured the imperial crown (1452). He was expelled from Vienna by the Hungarians (1485), but by the marriage of his son, Maximilian, to Mary of Burgundy in 1447, made his family, the Habsburgs, the most powerful in Europe.

Frederick I (1657-1713), 1st King of Prussia, became Elector Frederick III of Brandenburg in 1688, and sent help to William of Orange for his invasion of England. By pledging his support in the War of the Spanish Succession, he secured the royal title from the Emperor Leopold (1700). Frederick founded the Halle University (1693) and the Academy of Sciences at Berlin (1707).

Frederick II (1712-1786), of Prussia known as "the Great" succeeded his father, Frederick William I, in 1740. He was a disciple of Voltaire, and ruled as an enlightened despot. He reorganised the army, and in the wars of 1741-5 wrested Silesia from Austria, which he regarded as his supreme enemy. He allied himself with England (1756) against Austria, France, Russia, Sweden, and Saxony, and invaded the last, thus precipitating the Seven Years' War. Prussia's great victory established the kingdom as a leading European Power. Frederick annexed Polish Prussia (1772) and Franconia in the Bavarian Succession War (1778). He regarded himself as the "first servant of his people", and apart from his military interests, he promoted industry and agriculture, and fostered education, though he established a tradition for unscrupulousness in Prussian foreign policy.

Frederick III (1831-1888), King of Prussia, also Emperor of Germany. He married Princess Victoria of Great Britain in 1858. As crown prince he was a strong Liberal, and influenced the foundation of the German empire, frequently opposing Bismarck. He commanded forces in the wars with Denmark (1864), with Austria (1866), and with France (1870-1). He became regent (1878) and Emperor of Germany in the year of his death.

Frederick VIII (1843-1912), King of Denmark, succeeded his father, Christian IX, in 1906. His second son, Charles, married Princess Maud, daughter of Edward VII of England, was chosen King of Norway (1905) under the name of Haakon VII.

Frederick Louis, Prince of Wales (1707-1751), Prince of Wales 1729, eldest son of King George II. He married Augusta, daughter of the Duke of Saxe-Gotha, his son later becoming George III. His dissolute life, and his hostility to the Prime Minister, Walpole, brought him into disfavour with his father, who ordered him from St James's Palace, and refused him a command against the Jacobites (1745).

Frederick William (1620-1688), the "Great Elector" of Brandenburg. On becoming Elector in 1640 he began the rehabilitation of Brandenburg and Prussia from the losses of the Thirty Years' War. He annexed E Prussia, was recognised sovereign over Prussia by the treaties of 1657-60, and defeated the Swedes at Fehrbellin, 1675. The real founder of Prussia, Frederick reorganised its armies, founded a navy, promoted trade, and encouraged the settlement of Huguenots within his dominions.

Frederick William I (1688-1740), King of Prussia, father of Frederick the Great, succeeded Frederick I in 1713. Founder of the Prussian military system, he fought with success under Marlborough at Malplaquet (1709) and later annexed Gelderland and part of Pomerania (1720). His great achievements in internal adminis-

tration included financial and agrarian reform, the fostering of industries, the construction of schools and the organisation of an efficient bureaucracy.

Frederick William II (1744-1 97) King of Prussia succeeded his uncle Frederick the Great in 1786. He was a patron of Beethoven and Mozart but an extremely indolent ruler. He introduced repressive religious measures, establishing a Protestant Inquisition in 1791. In 1 9. he joined Austria in a war against the French revolutionaries who forced him to surrender his territories W. of the Rhine (1 93). He extended his dominions by the partition of Poland but his reign, generally, was marked by a national decline.

Frederick William III (1 70-1840) King of Prussia succeeded his father Frederick William II in 1 97. His kingdom was finally conquered by Napoleon at Jena in 1806 and by the Treaty of Tilsit (1807) Prussia virtually became a French dependency. Aided by Stein and Scharnhorst, Frederick William reorganised the army and with Austria and Russia overthrew Napoleon at Leipzig (1813). After 1815 he joined Alexander of Russia in the Holy Alliance and co-operated in Metternich's policy of political repression. He laboured to reunite Prussia and effected an agreement between the Lutheran and Reformed Churches in 1834.

Fredricksburg, Battle of (American Civil War) (Dec. 13 1862) the Federals under General Burnside attacked the Confederates under General Lee who were occupying a strong position on the hills; they were repulsed but Lee was unable to follow up his advantage.

Freebench, in England the right of a woman during widowhood to an interest generally one-third in her late husband's copyhold land, abolished in 1925.

Free Churches, a generic title covering the non-established Protestant Churches in the United Kingdom.

See also PROTESTANTISM BAPTISTS METHODISTS etc.

Free Church Federation, see GENERAL COUNCIL OF EVANGELICAL FREE THINKERS.

Free Church of Scotland, a body of Scottish Presbyterians which seceded from the Presbyterian Church of Scotland in 1843, the movement, headed by Dr Thomas Chalmers (q.v.) being known as the Disruption. Lay patronage re-established in Scotland by an Act of 171 was disliked by the Scottish Presbyterian and in 1834 the General Assembly passed the Veto Act whereby no pastor could be imposed contrary to the will of the congregation. Courts would not admit the legality of this and the English Parliament refused to remedy matters; many Scottish Presbyterians broke away and formed the Free Church of Scotland with Dr Thomas Chalmers as first Moderator. Fund came from voluntary gifts and the Free Church was most active in the 19th cent. In 1889 a split occurred over the question of Liberal theological views. In 1900 the Free Church and the United Presbyterian Church joined as the United Free Church of Scotland. A small remnant of the Free Church refused to combine. Finally in 19 9 the United Free Church of Scotland joined the Established Church and formed the United Established Church of Scotland. See also SCOTLAND CHURCH OF.

Freehold, see ESTATE TENURE.

Free Lance, originally a soldier who fought as a mercenary for anyone who would pay him for his service. The term is now applied to a writer, artist, photographer etc. who works for the newspapers or periodicals but is not on the regular staff of any such publication. Also often applied to anyone who is not allied to any party, political or otherwise.

Free Libraries, libraries supported by municipalities, counties or charitable institutions and available to the public free of charge. The first was established in Manchester in 1653. The

Library Association of England was founded in 1877, and since 1881 the Carnegie Trusts have contributed huge sums to the formation of public libraries. Municipal free libraries, supported out of the rates, are now the commonest form, and c. £2 millions is spent annually in England and Wales on their upkeep. They are open to ratepayers and to others living in the neighbourhood on the recommendation of a ratepayer.

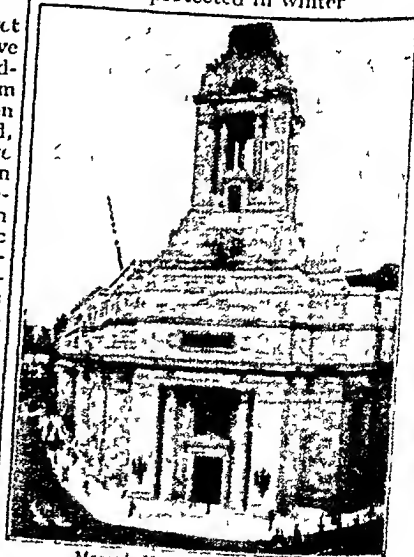
Freeman, one who is neither a slave nor a serf (*see* SERFS, FEUDALISM). Now used of a member of a livery company, e.g. the Grocers Company of London. Freedom is obtained in most companies by apprenticeship, purchase, inheritance, or gift. There are free-men of boroughs with certain rights and duties, and the title of Honorary Freeman is awarded to persons of distinction like a honorary degree.

Freeman, Edward Augustus (1823-1892), historian and Regius Professor at Oxford (1884-92). His best-known work is *The History of the Norman Conquest* (1867-79).

Freemasonry, a cult with a secret ritual, considered by some to have originated with Solomon and the building of the Temple, but in its modern form dating from the mid-18th cent., when the Grand Lodges of England, Scotland, and Ireland were constituted. There are now lodges all over the world. In England the Freemasons, as Freemasons, do not mix in politics, but on the Continent they do, the Catholic Church forbids its adherents to become Masons. The English Freemasons maintain schools for the sons and daughters of distressed or deceased Masons, and other charitable institutions. The new Masonic Temple in Great Queen Street, London, opened in 1933, is now the headquarters of the society, and is, architecturally, a remarkable building in the modern style. It is said that originally the Freemasons were working masons, but now, although building terms are employed in the ritual, the members are mainly well-to-do business-men.

Free Ports. Ports or special quays where goods loaded and unloaded from vessels of any nationality are not subject to import and export duties or other fiscal control. Storage and even manufacturing may be carried on without interference in free ports, which enjoy certain extra-territorial rights. The Hansa towns and many Italian ports were free in the Middle Ages, but the privileges were withdrawn in the 19th cent in most cases. At the present time the principal free ports are at Copenhagen, Danzig, and Hamburg in Europe, Hong-Kong, Singapore, and Penang in the East, and New Orleans in the U.S.A.

Freesia, fragrant white, waxy flower which grows in a one-sided raceme on a long stem which has a right-angled bend beneath the flower-bearing length. It may be grown out of doors in the S. of England, in a sunny well-drained border in light but rich sandy soil. The bulbs are planted in Aug. 2 in deep and 2 in apart, and the plants should be protected in winter.



Masonic Headquarters, London

Freestone, bedded sandstone in which the individual beds are not subdivided into laminae and which in the absence of this minor stratification can be cut into blocks in any direction without the blocks showing a tendency to split in one direction more than another. Hence it makes a good building stone. The Craigleith sandstone of Edinburgh is a well known freestone.

Sometimes the term is applied also to limestones such as the oolitic limestone of Bath (*see* **BATHSTONE**).

Freetown, port and capital of Sierra Leone. Public buildings include the Wilberforce Hall Cathedral and several schools, one of them opened in 1905 by the Prince of Wales. Formerly extremely unhealthy. Freetown has been made fit for European residents by a new and thorough system of drainage. Pop (1931) 55 400.

Free Trade, international trade without import taxes. Free Trade almost ceased to exist in the world when Great Britain the last great free trade country abandoned the system in 1931. *See also* **TARIFFS**.

Free Verse, a form of verse of which it is hardly possible to give any but a negative definition. In it all the traditional canons of form metre and rhyme are rejected and it depends for its music upon the rhythm of cadences apt to or suggested by the matter or substance of each individual poem and each individual line of such a poem. It has been widely used in Europe since and immediately before the World War but it is actually much older than this. Much of the Authorised Version of the Bible and notably the Song of Songs is Free Verse at its very best. It has been used by among other poets Richard Aldington T S Eliot and Ezra Pound.

Freezing point, the temperature at which a liquid assumes the solid state. The freezing points of pure substances are constant under the same conditions of pressure (a variation in which causes a slight variation in freezing point)

but the presence of substances in solution in a liquid has the effect of lowering the freezing point. This phenomenon is both of practical and theoretical importance. Practically it is made use of in the manufacture of freezing mixtures which consist of aqueous solutions of various salts usually sodium chloride. These solutions can be used in refrigerating machines since they remain liquid at temperatures considerably below that of the freezing point of pure water. The theoretical importance of the lowering of freezing point by the presence of a solute is based on Raoult's law which states that the lowering of freezing point in the same weight of the same solvent caused by equal weights of various substances is proportional to their molecular weight. This is therefore an excellent method for the determination of molecular weight, and it is used to a considerable extent especially in research work in organic chemistry where new and complex compounds are continually being produced the determination of whose molecular weight by other methods would be tedious and difficult. The solvent used in these cases is very often camphor which has a freezing point of 175 C in the pure state.

Freiburg im Breisgau, German town in Baden c 70 m S of Strasbourg at the foot of the Schlossberg. Notable buildings are the university (15th cent) and minster (13th cent). There are manufactures of tobacco silk but tons paper and musical instruments. Freiburg was the scene of several battles in the Thirty Years War. Pop 93 800.

Fremantle, port and town at the mouth of the R Swan in W Australia. Manufactures include shipbuilding metal founding brewing tanning and saw milling. Pop (1931) 35 000.

French Sir John, *see* **JAMES JOHN DENTON PINKSTONE FRENCH 1ST EARL OF**.

French Chalk, a form of steatite or talc (qv) used by tailors for marking cloth for which its softness

bility on the material make it very suitable. It is easily removable when desired, however. It is used as a dusting agent to prevent adhesion of tacky surfaces, as a filler in plastics, and to polish floors. It is at once distinguished from ordinary chalk by its greasy feel.

French Congo, name of the French colonies in Africa until 1910, when the official title was changed to French Equatorial Africa (*q v*).

French Equatorial Africa, is the general name given to the French colonies of Gabon, Middle Congo, Ubangi-chari, and the Chad territory, of which the capitals are respectively Libreville, Brazzaville, Bangui, and Fort Lamy. Frontiers have been defined by treaties, and are S, the Congo, N, Italian Libya, E, Anglo-Egyptian Sudan and Belgian Congo, and W, Nigeria. The coast is short, and extends only between Libreville and Loango. The territories, which are administered from Brazzaville, are watered by affluents of the Congo and the Shari, and other non-navigable streams. The entire region is backward in development, though there are great resources of timber, rubber, and palm oil. Coffee and cotton are being introduced, and in the Chad territory, which is the only district not heavily forested, herds of cattle, sheep, camels, and horses are raised. Ivory and ostrich feathers are exported, and there are believed to be deposits of lead, zinc, and copper, in various districts. The French have established schools, telegraphs, and a railway (opened 1930) between Brazzaville and the Atlantic.

The French are introducing various hygiene and medical measures, but disease is rife, and the population tends to shrink. Government is carried on in each colony by a Lieutenant-Governor, responsible to the Governor, who is assisted by a Council and a Secretary-General.

French influence began on the coast, steadily extending inland after Stanley's exploration of the Congo.

Other settlements in the Upper Nile district were joined to the Congo territory, forming the nucleus of the great *bloc* which now exists. Early efforts at private enterprise with State aid were unsuccessful, and later the Government took full control, establishing the whole colony in its present form in 1910. Total area, 912,000 sq m; pop (mostly negroes) (1931) 3,192,000 (3000 Europeans).

French Guiana, see **GUIANA**.

FRENCH

French Guinea, French colony on the upper W African coast, lying between Portuguese Guinea, the French Sudan, and Sierra Leone. The surface consists of a number of terraces rising to a high tableland. The chief rivers are the Niger, Senegal, Gambia, and Rio Grande. The climate is wet and hot. Large crops of rice, millet, fruit, and coffee are produced; palm oil and rubber are exported, cotton goods, machinery, and wine imported, and cattle raised. The country is well developed, and possesses good communications, schools, and social services in the larger towns of Kona, the chief port and capital, Benty, Kindia, Boké, and Timbo. The colony comes under the direction of French W. Africa, but there is a fair degree of autonomy under a Lieutenant-Governor. Measures for the further improvement of hygiene and education are being undertaken.

Known to the early Portuguese explorers, the district was explored in the early 19th cent by the French, who entered into relations with the native chiefs, several of whom came voluntarily under French protection. Frontiers with British and Portuguese possessions were settled by treaty. Area, 91,000 sq m; pop (1931) 2,237,000 (1100 French).

French India, general name for the French possessions in India, which cover a total area of c 200 sq m. They mainly consist of cities and their environs. Pondicherry is the most important, and others are Pulgaret, Villenour, Chardernagore, Tiru-

bouvane and Mahé. They are divided into the five provinces of Pondicherry, Chanderagore, Karikal, Mahé and Yanam. Chief crops are rice and groundnuts. There are flocks of cattle and sheep and a few cotton and jute mills. Total pop. (1931) 980,500.

French Indo-China comprises Cochinchina, the protectorates of Annam, Cambodia, Laos and Tonkin (qqv). Hwang Chan Wan is leased from China. The entire territory is administered by a Governor-General and each protectorate has a Resident-Superior. Trade and finance are managed by a grand council and by smaller councils for the protectorates. There is a common budget and common defence, postal services, public works, railways, customs and education. The main exports are rice, rubber, coal, fish, pepper, cattle and hides, zinc and tin. Imports include textiles, manufactured goods and oil. Area, 286,000 sq. m. pop. (1931) 21,650,000 (40,000 Europeans). See also INDO-CHINA.

French Language, The, is the form in which Vulgar Latin developed in N. France, being the *langue d'oïl* as distinct from the *langue d'oc* or Provençal (qv) of the S. The words *oïl* and *oc* are respectively the Old French and the Provençal for *yes*, the former being derived from Latin *hoc illud* (this is it) and the latter from Latin *hoc* (this). Of this N. language there were and still remain several dialects or *parlers*, the most important of which (in its relation to the English language) was that of Normandy, but it was the *Francien* of the Île-de-France which became the standard dialect which is now known as French. By the 15th cent. *Francien* had definitely established itself as the language of France and the other *parlers*, such as *Picard*, have survived since then only as dialects.

In considering the phonetics or pronunciation of French, the first thing that must strike the observer is the remoteness of its connection with the orthography or spelling. There must

for example be some reason for the various spellings *parler parlar parlais parlant parlant parlé* which all have approximately the same sound [PAHRLÄ]. Latin was a highly inflected language and Vulgar Latin was only less so. The various spellings listed above represent various French Vulgar Latin inflections of the verb *parler* and originally these were distinguished in pronunciation as well as in spelling. Up to about the 16th cent. French was (as was also English) pronounced more or less as it was spelt, but chiefly owing to the invention of printing the orthography became fixed while the spoken language went on changing. Thus while the written language retained many inflections the spoken language lost them and one spoken word came to be represented by variously spelt grammatical forms. The result is that while French orthography has little more relation to the pronunciation than is the case with English it has the advantage of indicating to the eye the grammatical relationship of words to one another in a sentence.

A salient feature of the phonetics is the presence of nasalised forms of the vowels *a*, *e*, *o* and *u*, a change which came into the language at about the 11th cent. The other main characteristic which strikes the foreign ear is the precise and staccato effect of French speech. This is due to the almost complete absence of a stress accent which results in a succession of almost equally stressed syllables which are poured out rather like shots from a machine gun.

In the development of its vocabulary and grammatical and syntactical structure there are three main periods of French: Old French (before the 16th cent.), Middle French (c. 1400-1600) and Modern French.

Old French nouns and adjectives had two distinct cases, nominative and accusative, but these distinctions vanished in the 16th cent. Now there is no difference except in the spelling between the singular *livre* and the plural *livres*. The plural in *s* has

become the regular rule, and many of the departures from this rule are merely the result of certain phonetic considerations. As in English, only certain pronouns have preserved the older system of declensions. Adjectives have developed in the same way as nouns, except that, since French has two grammatical genders, they have both a masculine and a feminine form. All the features of modern French grammar, including the conjugation of verbs, have developed more or less according to one principle. One particular form of the Vulgar Latin declension or conjugation became the pattern to which all French nouns, adjectives, and verbs tended to conform, and though French still has four conjugations analogous to those of Latin, these do not differ from one another so widely as do their Latin prototypes.

In Old French the words of a sentence could be placed in several orders without affecting the meaning, simply because the meaning was clear from the grammatical case-endings which were still preserved. But when these inflections were lost, it became necessary to make the meaning dependent upon the word order, and the regular sequence of Subject, Verb, Object was evolved. Again, while there was still a difference in pronunciation between such words as *parlais* and *parlant*, it was unnecessary to distinguish these by prefixing the pronouns *je* or *il*, and the modern use of pronouns with the verb became inevitable in order to avoid confusion when such phonetic distinction had disappeared.

The actual vocabulary of French is, as has been implied, in the main derived directly from Vulgar Latin, but a certain proportion of it has been borrowed from other sources. There has always been, and there still is, a fairly steady borrowing from classical Latin and Greek, very similar to that of nearly every modern European language. But the very word *France* is not a Latin, but a Teutonic word, taken from the German Frankish

conqueror of Gaul; and there are more than 400 common French words that are of German origin. Other Teutonic languages from which French has borrowed are English, Scandinavian, and Flemish. French has also adopted a considerable number of words from other Romance languages, such as Italian, Spanish, and Provençal. For the relation between French and English, see ENGLISH LANGUAGE.

French Literature. Leaving out of consideration certain remoter beginnings, it may be said that French literature began with a body of narrative poems, largely epic in character, which are known as the *Chansons de Geste*. These tell of the heroic exploits of antiquity, of French history, and of Arthurian legend, and the most famous of them is the *Chanson de Roland* (c. 1080), which tells of the last battle of Charlemagne and Roland, at Roncevaux (*qv*). About a century later than this was the work of Chrétien de Troyes (*qv*) in the field of Arthurian legend. Lyric poetry in these early times was represented chiefly by the songs of the Troubadours (*qv*) in the S., but, in the N., Thibaud de Champagne and Rutebeuf were notable lyricists. The 12th and 13th cents saw also a great output of popular and satirical poems, such as the *Romans de Renart*, a sort of fable in verse, and the *Fabliaux*, short tales in verse dealing realistically, and often satirically, with every aspect of bourgeois life. But the most important production of the 13th cent was the *Roman de la Rose* (*qv*). Of early prose, the history of the Ninth Crusade by Joinville (*qv*) is outstanding.

In the 14th cent poetry was dominated by the influence of the *Roman de la Rose*, but prose literature was enriched by the *Chronicles* of Froissart (*qv*).

The general poverty of 16th-cent. literature is emphasised by the unique glory of François Villon (*qv*), the criminal vagabond, who was one of the greatest purely lyric poets of all time. Apart from him, the chief work of this

century was the historical writing of Philippe de Communes

The mediæval French drama grew from the *Mysteries* dealing with religious subjects but a form of light comedy was also quickly developed full of vitality and popular appeal

In the 16th cent. the influence of the Renaissance upon French literature was quickly apparent and was first evident in the poems of Clément Marot (qv). But the freshness and new life of human thought found its supreme expression in François Rabelais (qv). Later in the century came a group of poets known as the *Pléiade* chief among whom were du Bellay and Ronsard (qqv) who strengthened and enriched the language by discreet and scholarly imitation of classical word formations. In prose the essay was created by Montaigne (qv) whose masterly expression of subjective thought and observation has scarcely been equalled

Early in the 17th cent. a name which is prominent largely owing to later allusions is that of Cyrano de Bergerac (qv) who as a dramatist anticipated many of the qualities of Molière. Régnier (1573-1613) wrote biting satires in the manner of Horace and Juvenal. There was a group of epuists called the *Précieux* and of grotesque parodists the *Burlesques* notable among whom was Scarron (qv). But the poet of the period who had the greatest influence upon subsequent literature was Malherbe (qv) who achieved a remarkable return to purity and simplicity of diction in contrast with the general extravagance of his contemporaries. There were many prose writers during the first half of the 17th cent. among them being Guez de Balzac (*Socrate Chrétien*), St. François de Sales (*Vie Dévote*) and Descartes the philosopher

Later in the 17th cent. which is called the *Grand Siècle* came a great number of the most famous writers both of verse and prose among whom by virtue of the exuberance of their output pride of place may be given to

the dramatists. There were literally scores of dramatists during this period and it is only possible to single out the three greatest. The first of these was Corneille (1606-1684) who may justly be called the creator of the modern French drama both tragedy and comedy. Racine (1639-1699) as a tragic dramatist is to a great extent the antithesis and the complement of Corneille. He saw the human passions as paramount over the human will whereas the key note of Corneille's thought is the victory of the will over the passions. Corneille was no doubt the greater and nobler apurit but there is in Racine a subtle and delicate feeling for the nuances of poetic thought which makes him perhaps the more readable. Molière (1622-1673) is one of the few very great comic dramatists of the world. He relied for his effect not upon wit of which there is little in his work but upon his capacity for directing the searchlight of his genius upon the essentially comic elements of any given situation. His is an appeal which has never failed of its response he himself leads the laughter in which he forces others to join.

All things considered the two greatest collections of French poetry in the 17th cent. were the *Fables* and the *Contes* of La Fontaine (1621-1695). His masterly control of the French language and the full use he made of its potentialities have seldom been approached by any other poet. The *Fables* and the *Contes* between them embrace a complete and faithful picture of 17th-cent. life in France executed with a precision an economy and a verbal felicity which remain the admiration of posterity.

Certain of the prose writers of this century stand out above the rest. La Rochefoucauld (1613-1680) lives in the epigrammatic polish and brilliance of his maxims. Pascal (1623-1662) was a man of very wide attainments but if he had to rely on his literary merit alone he would still be remembered for the *Provincial Letters* and the *Thoughts*.

In pure oratory Bossuet (1627-1704) is unrivalled, not only in the 17th cent., but in all French literature. It is doubtful if the art of letter writing has ever been more perfectly exemplified than in the Letters of Madame de Sévigné (1626-1696). Fénelon (1651-1715) wrote his *Télémaque* for the edification of his pupil, the Dauphin, but the work transcended its primary purpose, for no more scathing indictment, the more effective for its reticence, could have been written of the reign of Louis XIV.

The qualities of 17th-cent. French literature were epitomised in Boileau (1636-1711) who, as a poet, has a place analogous to that of Pope in English literature, and as a critic was acknowledged as the supreme literary authority of his age. La Bruyère (1644-1696) belongs, in spirit, partly to the next century. His *Caractères* are maxims in which he paints the tedium and futility of human life, but he is capable of moments of great tenderness. "A beautiful face is the most beautiful of all sights, and the sweetest music is the voice of the woman one loves."

The beginning of the 18th cent. is not marked by any notable achievement of poetry or of the drama, but in prose it is richer. Montesquieu (*qv*) in his *Lettres Persanes* embodied his views on practically every aspect of contemporary life, and had a very great influence on Voltaire and Rousseau. Saint-Simon, in his *Mémoires*, gives a vivid description of the Court of Louis XIV. The *Gil Blas* of Lesage is a notable example of the picaresque novel (*qv*). The Abbé Prévost, among a great deal of tiresome work, produced one masterpiece in the tale of *Manon Lescaut*.

Of the dramatists of this period it is enough to mention La Chaussée, who wrote domestic dramas in verse, and Marivaux, whose comedies are still acted with success.

The dominating figure in the second half of the 18th cent. is that of Voltaire (*qv*). Known first as a poet, he later became famous as an advanced, anti-

religious philosopher, and as such his influence extends far beyond the bounds of French literature or of literature in general. Purely and simply as a writer he owes his greatest fame to *Candide*, a salutary and sympathetic summing up of the disasters incidental to human life.

The famous *Encyclopédie* was built under the supervision of Diderot (*qv*) as a stronghold of Reason and Materialism, but apart from this monumental work, Diderot has a prominent place in literature by reason of his advocacy of a return to nature, and, notably, by virtue of *Le Neveu de Rameau*, which is by many considered his masterpiece.

The gospel of the return to nature found its greatest preacher in Jean-Jacques Rousseau (1712-1778). His troubled and varied life is of more interest than the bulk of his literary work, and it is his *Confessions*, where he tells the whole truth about that life, that have had a permanent influence on the literature, not only of France, but of Europe in general and of Russia in particular. Though he wrote in prose, he was in many respects one of the greatest of French poets.

The last great names in pre-Revolutionary literature are those of Beaumarchais (1732-1799), whose comedies *The Barber of Seville* and *The Marriage of Figaro* are at least as great as any in the language, and André Chenier (1762-1794), an exquisite poet who gave a gracefully wrought setting of classical verse to the thoughts and ideals of the new age. The prose masterpiece of Bernardin de St Pierre, *Paul et Virginie*, appeared in 1789.

The Revolution itself, as may be readily understood, produced little of permanent literary value.

Nineteenth-cent. literature begins in 1802 with *Le Génie du Christianisme* of Chateaubriand (*qv*), the champion of the essential poetry and humanity of Christianity. Chateaubriand was the herald of the imaginative romanticism which followed. Before passing to the main body of 19th-cent. literature, a reference is due to the German studies

and romances of Madame de Staël (1760-1817)

The romantic revival and the revolt against restrictive classicism quickly found poetical expression in the *Méditations* of Lamartine (1790-1869) in the dramas and *Odes* of Victor Hugo (*qv*) in the less imaginative but more equal and correct poems of Alfred de Vigny (1799-1863) and a little later in the subjective Alfred de Musset (1810-1857) and the objective Théophile Gautier (1811-1872). This succession of great poets is one of the most striking phenomena in literature and their enthusiasm and romanticism was worthily supported by the contemporary novelists and prose writers.

The French novel had its origins in the 17th cent in the shape of the cumbersome romances of Mlle de Scudéry and in Madame de la Fayette's *Princesse de Clèves* (1678). In the 18th cent Rousseau's *Nouvelle Héloïse* had much of the romanticism which characterises the later novelists. Lamennais (1782-1854) wrote no novel but his prose mainly dealing with religious subjects had a great effect upon subsequent novelists. Alexandre Dumas (1803-1870) is the supreme master of historical romantic fiction. George Sand (1804-1876) and Théophile Gautier wrote novels which have many of the qualities of lyric and idyllic poetry. Victor Hugo greater as a poet was scarcely less great in the three novels by which he is chiefly known outside France—*Notre Dame de Paris*, *Les Misérables* and *Les Travailleurs de la Mer*. In the *Comédie Humaine* a series of novels in which almost every aspect of contemporary life is pictured Balzac (1799-1850) shows himself as both realist and romanticist; his romanticism forces him into all sorts of distortions and improbabilities but his realism is such as to make even them appear possible and credible.

But the romantics did not hold the entire field of literature and the traditions of classicism still had their faithful adherents. The popular songs

of Béranger (1780-1857) the stories of Prosper Mérimée (1803-1870) the criticism of Sainte-Beuve (1804-1880) and the novels of Constant and Stendhal all remained untouched by the more prevalent romanticism.

In 1850-60 there began in fact a reaction against the romantic movement which was expressed in the philosophic positivism of Comte, Renan and Taine as well as in purely literary prose and verse.

The first of the new poets and a sort of link between the romantics and the Parnassians (*qv*) was Théodore de Banville (1833-1891). The main characteristics of the new poetry were a meticulous care in its form and a general pessimism of spirit. The most famous of these poets is Charles Baudelaire (*qv*) and others are Leconte de Lisle, Sully Prudhomme, François Coppée and Heredia.

The new realistic fiction is found though still tinged with romanticism in the work of Gustave Flaubert (1821-1880). *Madame Bovary* and *Salammbô* each in its own way struck a new note in French fiction. They were followed by the vivid realism of Guy de Maupassant (*qv*) and the un-realistic naturalism of Émile Zola (*qv*). Prominent among later novelists are Alphonse Daudet (*qv*) the creator of the immortal *Tartarin*, Henri de Régnier and Anatole France (*qv*) but the latter end of the 19th cent produced very many more novelists who might equally well be mentioned.

In poetry the successors of the Parnassians were the Symbolists (*qv*) whose literary watchwords were freedom and individuality. As a purely lyric poet Paul Verlaine (1844-1896) may almost rank in French literature with Villon. Others were Stéphane Mallarmé, Arthur Rimbaud and Albert Samain and many more who may be included in the rather vaguely defined limits of this school of poetry.

Nineteenth-cent drama is headed by the rather bombastic but still popu-

lar plays of Victor Hugo, Alfred de Vigny's *Chatterton*, and the graceful dramatic sketches of Alfred de Musset. From 1850 prose became the general dramatic medium, and Alexandre Dumas fils (1824-1895) was the foremost dramatist. Overlapping into the 20th cent came Edmond Rostand, whose *Cyrano de Bergerac* (1897) has qualities which have caused it to triumph over certain dramatic defects.

The field of French literature is so huge that many names, some even of the first importance, have necessarily been omitted in so brief a survey as this, and in dealing with the literature of the present century it is even more inevitable that there will be both emphasis and neglect which posterity will consider alike inexcusable. All that can be done is to nominate certain authors who appear to have made an indelible mark. Marcel Proust has been made familiar to English readers through the masterly translations of Scott Moncrieff. Another, more recent, author, whose books have gained much popularity in England, is Colette. It is, in fact, the novel which holds the chief place in modern French literature, and the name of its devotees is legion. In France also, more perhaps than in any other country, there has been a revolt against every accepted canon of literary language, and it is as yet impossible to judge to what extent such ultra-modernists are on the track of anything of real value.

French Polish, a method of finishing the surface of wood which imparts a hard polish to the surface. The wood is usually first filled and often stained. Filling is accomplished by means of a special filling case, which is spread over the surface of the wood so as to fill all channels formed by the grain, the excess being removed afterwards by glass paper when the filler has hardened. Stains (qv) are then applied to the wood, which is again rubbed down. The liquid used for polishing is a solution of orange-shellac in alcohol and contains wax. A piece of cotton-wool is soaked with

the liquid and wrapped in a linen cloth, and with this the work is lightly rubbed with a peculiar sweeping motion. Coat after coat is applied in this way, the process requiring great skill. The work is finally polished with a little linseed oil.

French Revolution, The (1789), overthrew the despotic Bourbon Monarchy, to be in its turn overthrown by the Empire of Napoleon, but the monarchy was not forgotten, for in 1830 and again in 1848 a monarchy was overthrown by a revolution in France. The French monarchy, for many years dominating Europe and resisting the attacks of several coalitions, brought about its own destruction. It made the nobility, possessors of many privileges, mere decorations in the splendid Court of Versailles, or generals in the armies of the King, many of its greatest advisers were drawn from the ranks of the clergy—Cardinal Richelieu for example—but it never allowed the Church to become dominant in the State, it hedged in the development of commerce with the reactionary customs regulations which made Colbert famous. It prevented the development of a politically powerful middle class, local particularism was broken down by a policy of centralisation, and by government by royal officers. The power of the monarchy was based, negatively on the fact that no class could oppose it effectively, and positively on loyalty and on military success. But this very policy of military adventure, pillar of monarchic power, and the privileges of the nobility, granted to keep them peaceful and prevent their opposition to the Crown, made impossible the continuance of that power. The wars of Louis XIV so exhausted the French treasury, that no more successful wars could be fought. But apart from financial difficulties, the grievances of the peasantry, who had to pay not only heavy taxes to the Government, but dues and services to their feudal lords, the complaints of merchants and industrialists, ham-

pered in their enterprise by restrictive regulations and the dissatisfaction of all those whose power the Crown had broken were important contributory causes of the Revolution. In the reign of Louis XV and again under Louis XVI the aristocracy tried to obtain greater power in face of growing unrest from the other classes. One more major influence is to be found in the Humanitarian movement the ideas of which spread until they became part of the theoretical background of the Revolution. All these factors together produced a situation favourable to revolution. It only needed the blundering and vacillating policy of Louis XVI to give it the initial impetus.

The Government of Louis XVI both before and after the convocation of the States General was a series of mistakes. For a short period Turgot was a minister of the Crown. He put forward a series of reforms which had they been carried out might have prevented the Revolution. He incurred the enmity of Marie Antoinette and his place was taken by Necker who instead of reforms proposed a loan. Overthrown in 1781 he was succeeded by a series of ministers including the extravagant Calonne. An Assembly of notables was summoned but the state of the finances deteriorated steadily. Demands were made for a States-General and Necker was recalled. Louis XVI summoned the States to meet on May 1 1789 and thereby prepared the way for the Revolution. As yet the conflict was more between the privileged and the unprivileged orders with the King holding the balance. Louis compromised and fell between two stools. The States-General was at the outset divided on two council questions—double representation of the Third Estate and voting by heads or by orders. Given double representation the commons would have 600 members the nobles and clergy 300 each given voting by heads reform would have a majority as some of the nobles and a large body of

the lower clergy were reformers. Otherwise privilege was in power. The King swayed between Necker and Marie Antoinette and finally compromised. The commons were to have double representation and voting by orders seemed to be favoured by the King though he made no definite pronouncement. The commons demanded a joint session in which they would have a majority. They were refused and on the motion of the Abbé Sieyès proclaimed themselves the National Assembly. The King closed the sitting whereon they assembled elsewhere. The King then gave out his policy. He desired reform in fiscal matters and the estates were to sit and vote separately. The match in the powder magazine was lit. The military refused to act against the Third Estate now joined by many minor clergy and a few nobles. On July 14 the Paris municipal guard stormed and captured the Bastille hated symbol of the old régime. The King was forced to give way and the States General or the greater part of it became the Constituent Assembly. There were three parties in France the King swayed now by extreme royalists now by moderates. The Assembly on the whole moderate favouring a constitutional monarchy and Paris hungry half unemployed ready to listen to the revolutionaries organised in their clubs such as the Cordeliers and the Jacobins. The Assembly devoted itself to constitution making and reforms. On August 1 the Declaration of the Rights of Man was adopted and on the 4th feudalism was abolished. This brought the peasantry to support the Revolution. The Constitution introduced by the Assembly gave legislative power to the National Assembly executive power to the Crown and its ministers (whom a rigid separation of powers prevented from sitting in the Assembly) and set up an elective judiciary. Other reforms were introduced the system of local government was remodelled the modern depart-

ments taking the place of the old divisions. This was to prevent any local sentiment breaking up national unity. Later Federation, or the suspicion of it, was to lead many to the guillotine. The attitude of the Assembly to religion was ultimately to precipitate a crisis. The Government confiscated Church property and made the priests take oaths and become little more than civil servants. This influenced the King—a strict Catholic—away from the Revolution, with which he had previously had some sympathy. Twice in this period the people intervened, once to force the King to leave Versailles and live at the Tuileries in Paris, and again to prevent him from receiving his Easter Communion in 1791 at the hands of a non-Constitutional priest. The King took fright and fled from Paris. He was captured and brought back, the Assembly intended to complete the Constitution and then, if Louis accepted it, reinstate him as King. But the violent temper of the people led to the massacre of the Champ de Mars, which widened the rift between moderates and extremists. The Constitution was accepted by the King in Sept 1791, and the first legislative Assembly took the place of the Constitutional Assembly.

At first the King chose his ministers from the moderates, who were in a majority in the Assembly but the protests against the Government forced him to choose another ministry, from the more extreme Girondists. The alarm of the foreign powers and the suspicion that they were going to try to put down the Revolution by armed intervention, pointed to war, which was favoured by the extremist sections on both sides, and was finally precipitated over the Declaration of Pillnitz (qv). The opening stages of the war were disastrous, and the people grew suspicious of their leaders. In August 1792 they attacked the Tuileries, the King took refuge with the Assembly and his functions were suspended. The As-

sembly decreed that a new Constituent Assembly elected by manhood suffrage should be summoned. Meanwhile a Municipal Council or Commune was appointed in Paris, which was to dominate the Assembly, the enemies of the Revolution were tried by a tribunal appointed by the Commune. The rising feeling of the people culminated in the Sept massacres, and a terrorist policy which was supported by the policy of Marat. The Constituent Assembly established the Republic in 1792, and King Louis was tried, condemned to death, and guillotined (Jan 1793). The conflict between Girondins, now moderates in the Assembly, and the Jacobins increased. An insurrection in the Gironde confirmed the opinion of the Jacobins that the Girondists were federalists. The Assembly, under the necessity of war, elected an executive committee, the first committee of Public Safety, in which Danton and the extremists obtained supremacy.

The Government of the Committee of Public Safety, established in April 1793, is marked by Danton's unsuccessful attempt to co-operate with the Girondists. The Paris mob demanded the denunciation of the Girondists as enemies of the public safety, and many were arrested. With the fall of Danton in July 1793, the Committee, influenced by the "Triumvirate," Robespierre, Couthon, and St. Just, dominated the weak Assembly, or Convention, as it was called. In addition there were other parties: the supporters of Danton; the Commune, led by Hébert, which put forward many proposals, including a new calendar and a new religion, accepted by the Convention, and in addition reformed many of the organs of local government in Paris. Of these parties, that of Robespierre triumphed. Hébert was executed in March 1794. Robespierre's party having obtained mass support by a law introduced by St. Just, whereby property confiscated from suspects was to be given to the poor. Danton was executed in April.

for having opposed the reign of terror too ardently after his fall from power. The Terror originally arising from fear and from the danger in which this new republic found itself served its purpose in the ruthless extermination of traitors and inefficient generals. Victories at Wattignies in 1793 and Fleurus in 1794 freed France from immediate danger but the Terror was continued as a method of exterminating opposition to the dominant party. It had gone too far and the Convention too not knowing who would be the next victim ordered Robespierre's arrest. He was released by the Commune. In the conflict the Convention defeated the Commune for the first time. Paris was sick of the guillotine and did not rally to the aid of the Commune. In July 1794 Robespierre was executed and the reign of terror passed. The Commune was broken up the Committee of Public Safety was brought under the control of the Convention and in November the Jacobin Club was disbanded.

The Convention faced with a severe winter and much hardship and unemployment had to repress risings at Paris in April and May 1795. In the latter rising they used the regular Army. The death of Louis's son in June left the Comte de Provence the heir to the throne fighting in the armies of the Coalition. The Convention therefore was urged to declare its position and brought forward what is known as the Constitution of the Year Three more conservative than that of 1793. The executive committee was a Directory (q.v.) of five members and the Legislature consisted of two houses elected by those with certain property qualifications. The Constitution provoked a rising in Paris in October put down again by the use of regular troops (henceforth the Army was to play an important part in internal politics).

The four years of the Directory were not marked by successful government. The Constitution still dominated by the theory of the separation of powers

which has hampered other countries was unworkable. There was no harmony between Directory and Legislature the former still Jacobin in tendency and the latter moderate. The elections in March 1797 showed gains for the moderates but the Directory used the Army to nullify the elections. This happened again in the following year. The Directory had lost touch with both extremists and moderates. Its anti-Catholic religious policy offended the peasants who might otherwise have supported it. The Revolution in its constitutional side was dying. The foreign policy of the Directory killed it. War was waged unsuccessfully against Austria (see FRENCH REVOLUTIONARY WARS) and when the tide was turned in the French favour the gains rebounded more to the credit of Napoleon than to the French Government whose orders he often disobeyed. Dispatched to Egypt to attack the power of the English he returned to find the Directory shaken by a fresh series of military disasters and by insurrection at home.

In October 1799 the Constitution was abolished and a new one devised under the influence of Sieyès supported by Napoleon. A complicated system of legislation was to be managed by three Consuls and a Grand Elector. Napoleon as first Consul got rid of Sieyès by abolishing the latter post and a plot against his life gave him the opportunity of ridding himself of other too prominent democrats. He consolidated his power by a series of brilliant victories in Italy and by conciliating the Conservatives in the Concordat of 1801 with the Roman Catholic Church. The Revolution had been turned into a dictatorship and in 1804 the Senate conferred the title of Emperor on Napoleon and he was crowned by the Pope. Henceforward with a short exception in 1848 until the establishment of the Third Republic after the Franco-Prussian War France was to be governed by upstart Emperors or Bourbon monarchs.

In spite of its supersession by the Empire, the French Revolution had an enormous effect both in and out of France. The abolition of feudalism, the confiscation of the estates of the Church and of the opposition and the emigrés, improved the status of the peasants and made the economic development of France slower and more balanced than that of England. The Revolution also freed trade from the restrictions of the old regime. Corporations and combinations were forbidden by a law of 1791. The growing importance of the merchants (shown in the second French revolution of 1830) was partly helped on by the French Revolution. The *code civil*, the basis of the modern French legal system, was the work of Napoleon's lawyers, not a little influenced by the ideas and theories of the Revolution.

Liberalism and reaction equally intolerant of each other came into actual conflict time and again in the early 19th cent in insurrection and revolution.

Abroad, the Revolution strengthened the forces of liberation and provoked a series of uprisings, nationalist and democratic, in most countries in Europe.

Consult Belloc *The French Revolution*, Bradby, *Short History of the French Revolution*, Grant-Tinkerley, *Europe in the 18th Century*, Part I, *Contemporary Modern History*. Carlyle's *French Revolution* is a work of art rather than a history.

French Revolutionary Wars, fought between France and various continental countries from 1792 to the Peace of Amiens 1802 (see Napoleonic Wars). **PRUSSIAN CAMPAIGN**. WATERLOO CAMPAIGN for the later stages of the struggle between France and the greater part of Europe. In 1792 France declared war on Austria because of the refusal of the Emperor to allow it to repossess the provinces it had lost in 1701. It was the first of the wars of the French Revolution. The terms of the peace of 1792 were not very strict. The French were to be driven out of the

the campaigns leading to the expulsion of invading armies from France (1792-5), French invasion of Germany (1796) and Italy (1794-7); Second Coalition's war against France (1798-1800), and the naval operations of the wars, mainly between France and England. The outbreak of the war in 1792 was followed by an Austrian invasion of France. These attacks were repulsed after a series of French reverses by General Dumouriez at the battles of Valmy and Jemappes, and the French armies invaded the Low Countries. The second year of the war saw Austria, England, Holland, Prussia, Sardinia, and Spain in what is called the First Coalition. In March 1793 the French were defeated at Neerwinden and the way to Paris lay open. But divided countries among the Allies helped the French, and instead of marching on Paris the Allies moved W. to capture the fortresses Valenciennes, Lille, Dunkirk (see sketch-map). In 1791 the French recovered, defeated the Allied army, at Mondschoote though not decisively, and relieved Maastricht by the battle of Wattignies.

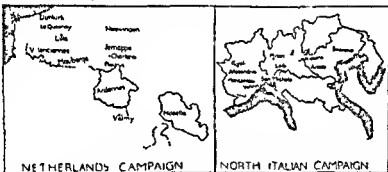
The campaign of 1791 was fought in the neighbourhood of Tournai. The French drove back the Allies at the battle of Tournai. Later in the year the two French armies, of the Moselle and Ardennes, defeated their opponents at Neerwinden. As a result of these successive defeats Austria and English troops withdrew, leaving Holland at the mercy of the French armies. Meanwhile on the Rhine the Prussians, at first Hermann had been repulsed after initial French success. The French armies had driven the Prussians out of Nancy and had taken Metz, and had been almost within Maastricht in Spain.

The peace of 1792 was not very strict. The French were to be driven out of the provinces they had lost in 1701. It was the first of the wars of the French Revolution. The terms of the peace of 1792 were not very strict. The French were to be driven out of the

here with the armies then operating in Italy. Jourdan, the French General, was to engage the Austrians while Moreau invaded S. Germany. The French were defeated at Amberg and Würzburg but were able to retire in an orderly fashion.

The Campaigns in Italy before 1795 when Napoleon obtained command were not of great importance. Savoy and Nice were conquered and French armies operated in the Alps and on the Riviera. In 1796 Napoleon, with an army deficient in numbers and equipment, was faced by the separate Piedmontese and Austrian armies and attempted to crush them

could more easily be obtained. The Austrians retreated into the N. Italian plains followed by the French who forced a passage across the R. Adda at Lodi in the teeth of the Austrian rearguard. The French obtained possession of Milan and its neighbourhood and pressed forward and besieged Mantua. The siege was raised and Napoleon was forced to attack the Austrian army or retreat towards Milan. He chose the former alternative and defeated the Austrians at Castiglione. Following them into the Tirol, Napoleon had to return as the Austrians had slipped past him and were marching to the relief



Sketch-map of the Theatre of the French Revolutionary Wars.

one after the other. The Piedmontese and Austrians effected a loose junction and the Austrians marched on Voltri and Genoa whence came much of the French supplies. A French detachment held Voltri and then, having engaged the attention of the Austrians, evacuated it. At the battle of Montenotte the French defeated the part of the Austrian army lying nearest the Piedmontese. A wedge had now been driven between the two armies and leaving a part of the army to hold the Austrians, Napoleon defeated the Piedmontese at Vico and expelled them from the war by the armistice of Cherasco. The way lay open to the fertile plains of N. Italy where food for the army

of Mantua. The French defeated the Austrians at Bassano and pursued them to Mantua. The Austrians then sent another army to relieve Mantua. At the battle of Arcole the Austrians were repulsed with difficulty and both armies were too worn out to continue the struggle for some weeks. In 1797 the Austrians were defeated at Rivoli and shortly after Mantua surrendered and the peace of Campo Formio ended the war. Then followed in 1798-9 the interlude of Napoleon's expedition to the East. Cut off by the British fleet from France, he inflicted a series of defeats on the Turkish armies.

The Second Coalition, formed of Austria, England, Portugal, Russia

Turkey, and the Holy See, continued the wars against France in 1798. Early operations in Switzerland and the Tirol went against the French troops, and in 1799 the main Allied offensive was launched in Italy. Under the leadership of the Russian Emperor the Allied armies defeated the French in a series of encounters and drove them back to Alessandria. A French army from S. Italy was defeated at the Trebbia and driven back to Genoa. The French won a minor victory at Döttingen, in Bavaria, and Suvorov was unable to make any headway in the Alps, but the opening stages of this war had been disastrous for the French. When Napoleon became First Consul the tide turned. With a reorganised army he marched into Italy and headed for Milan, his purpose being the defeat of the Austrian Army, not the relief of the French troops besieged in Genoa and elsewhere. At the battle of Marengo the Austrians were decisively beaten and the French overran the whole of Italy. This battle was followed by the victory of the French at Hohenlinden in Germany, which ended the war with the Second Coalition.

England during the Revolutionary and Napoleonic Wars was the most determined enemy of France. Her victory and France's ultimate defeat depended on the mastery of the sea. The opening naval operations consisted in encounters of little importance between English and French fleets and the capture and abandonment of Toulon by the English. The later stages were of major importance. At the battle of St. Vincent (1797) the Spanish, then Allies of the French, were defeated. In the next year Nelson's victory at the Nile cut off Napoleon's communications with France, and in 1801 the Danish fleet, then allied to France, was destroyed by Nelson at the battle of Copenhagen. The Peace of Amiens closed the war between England and France. Further hostilities against England were checked by the Battle of Trafalgar

in 1805, and were finally abandoned after the Battle of Waterloo in 1815, at which, in spite of his elaborate preparations, Napoleon was heavily defeated. *See also* NAPOLEONIC WARS.

French Somaliland, *see* SOMALILAND, FRANCE.

French West Africa, territory comprising the colonies of Senegal, French Guinea, Ivory Coast, Dahomey, Sudan (French), Niger, and Mauritania (q.v.). The various boundaries have been established by Anglo-French agreements. The entire territory is administered by a Governor-General assisted by a council, Dakar being the seat of government. Each colony is administered for local affairs by a Lieutenant-Governor. There is a general budget. Education, defence, and customs are in the hands of the central executive.

French West Indies, several islands in the Lesser Antilles, of which Martinique and Guadeloupe (q.v.) are the most important. Others are Marie Galante, St. Barthélemy and Désirade.

Frere, Sir Henry Bartle Edward (1815-1884), British administrator. From 1834 he held important posts in India, and during the 1857 Mutiny not only maintained order in his own area, but sent troops to aid Lawrence in preserving the peace of the Punjab. He was later Governor of Bombay. In 1877 he was sent out as High Commissioner in an attempt to form a united S. Africa. The disastrous Zulu war of 1879 was followed by a rising among the Boers in the Transvaal, and Frere was recalled. He published his defence, *Afghanistan and S. Africa*, in 1881.

Frere, John Hookham (1769-1846), author and diplomat, held a difficult post in Spain during the Peninsular War. He is best known for his translations of Aristophanes into English verse, and his contributions to the *Anti-Jacobin*.

Fresco, name given to painting on plaster (from the Italian, meaning "cool," or "fresh"), also used in English in the phrase *al fresco* (in the open air).

Fresco-painting can be classified into two types that done direct on newly laid wet plaster known as *buon fresco* and painting on plaster that has dried—a *secco*. Most artists have been forced to resort to the second method to a varying extent in order to make retouchings in their original work, but the ideal of fresco painting was to finish each part of the picture on the wet plaster and not touch it again.

The process of fresco painting was known to the ancients and is described by Vitruvius as a method of colouring wall-surfaces. When pigment mixed with pure water only is applied to the freshly plastered wall a chemical process occurs which fixes the colour in a layer of carbonate of lime that forms on the surface and gives a great degree of permanence. Properly painted fresco in suitable conditions retains its freshness of colouring through centuries.

The revival of fresco in Italy began in the 13th and reached its highest perfection in the 15th cent. It was used in combination with mosaic for the interior decoration of Byzantine churches but with Giotto it began to supersede mosaic entirely and the lower church of S. Francis at Assisi contains some of the finest of early fresco paintings. All the early Italians used the medium and Michelangelo was probably not alone in regarding oil painting as a medium fit only for women. The last coat of plaster was applied to the wall only over such a portion as the artist expected to cover in one day; the design was then transferred from the cartoon by pricking the outlines and *pouncing* with coloured powder so as to make a dotted line on the wall.

Examples of cartoons ready pricked for this purpose are not uncommon. The outlines were then painted in the shadows put in with *terre verte* or with the darkest of the three shades of local colour usually employed the half tones in local colour being then applied and fused with the shadows

while the lightest tones were painted in last and the high lights added in white. Michelangelo's unfinished fresco of *The Virgin and Child with St. John and Four Angels* in the National Gallery shows the method of working clearly.

Giotto and Masaccio were two of the greatest early fresco painters and Michelangelo's work on the ceiling of the Sistine Chapel is probably the finest example of fresco painting in the world. These paintings were executed by him in 4 years single-handed lying on his back in a suspended cradle and working with his arms above his head. Luini was another painter who showed himself a master of the art of fresco.

Attempts have been made to revive the art but the greater part of mural paintings executed of recent years has been in tempera or in oils. In the 19th cent the paintings in the Houses of Parliament in London were carried out in fresco but displayed no power of resistance to the London atmosphere. On the other hand frescoes painted at the same period by Rethel at Aix la Chapelle and other examples abroad remain well preserved and it is possible that it was imperfect technique rather than atmospheric impurities which caused the rapid deterioration of the London experiments.

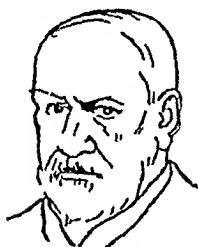
A number of processes have been invented such as fresco-secco, spirit fresco and water glass painting or stereochromy all of which aim at overcoming the difficulties of painting direct and once for all on the freshly laid plaster but it was largely the nature of these difficulties themselves that produced the peculiar beauty of the old Italian frescoes.

Fret (architecture) decorative pattern consisting of a continuous series of short straight lines or bars joining one another or interlacing, usually at right angles. This ornament which is found all over the world is used also in furniture and textiles as well as in the decoration of pottery and china. Thus it was carved, woven or painted.

It was common in ancient Greek art hence the term "Greek fret"

Fretwork is ornamental carving in wood, cut out with a fretsaw. Some interesting examples of fretwork are seen in many Chippendale tables and chairs, the modern amateur efforts are in a very different category.

Freud, Sigmund (b 1856), Viennese-Jewish psychologist, founder of psycho-



Dr Freud

analysis. Soon after taking his medical degree (in 1881) he heard of a remarkable case of hysteria being cured by hypnosis. This led him to the formulation of his system. His theories are fully dealt with under PSYCHO-ANALYSIS (q v).

Fréycinet [FRÄSINÄ], Charles Louis (1828-1923), French statesman, a government engineer. He became chief of the military cabinet in 1870, assisting Gambetta in the organisation of armics for the Franco-Prussian War, later, as Minister of Public Works, he developed the French railway and canal systems. As Minister of War (1888-93) he completely reorganised the army. He was four times Premier, and in 1915 joined Briand's War Ministry. Author of works on transport, labour, and industry.

Freyja, in Scandinavian mythology, goddess of love and the wife of Odin. She occupied in Norse myth the place of Venus in classical legend, possessed similar attributes, and was represented in a similar manner. Friday was named after Freyja.

Freytag, Gustav (1816-1895), German novelist, was also a journalist and playwright. His comedy *The Journalists* (1853) achieved renown, but his reputation rests on his great patriotic novel, *Soll und Haben* (1856), a description of the life of the commercial middle classes. Other works of a

similar kind comprise *Die Ahnen* (1872-80) a series of novels which traces the history of a family through the ages.

Friar, a Roman Catholic mendicant religious, distinguished from a monk (q v) by the fact that his vows bind him, not to a particular monastery, but to his Order as a whole. The principal Orders of Friars are the Franciscans and Dominicans (qq v), others are the Carmelites, Servites, and Minims. In pre-Reformation England the Franciscans were often called the *Grey*, the Dominicans the *Black*, and the Carmelites the *White*. Friars from the colour of their respective habits.

Friar-bird, Australian bird belonging to the family of Honey-eaters, its name being derived from its bald head and sombre plumage.

Friar's Cowl, see ARISARUM.

Fribourg [FRĒ-BÖRG] (1) W. Swiss canton between Vaud and Berne. Much of the surface is high, and includes Vanil Noir (7850 ft), Moléson (8000), and Berre (5050), the chief river is the Sarine, and the largest lake the Schwarzssee. Agriculture is the principal occupation, and the canton is noted for butter, cheese, timber, and tobacco. The chief industries are watchmaking, paper, and chocolate. Chief towns are Fribourg (the only large town), Bulle, Morat, Châtel, and St Denis. The people are predominantly Roman Catholic. Area, 650 sq. m; pop (1930) 143,000.

(2) Cap of the canton of that name, and the city around which the canton grew up, a large agricultural centre. The principal buildings are the Catholic university, the ancient town hall, and the 13th cent church. Fribourg was founded in the middle of the 12th cent. It was ruled by Burgundy and Savoy, and in the 15th cent became a member of the Swiss Confederation. Territory in the vicinity was steadily acquired, and in due course the present canton was established, with Fribourg as its capital. About two-thirds of the population are French, and the re-

Maunders German Pop (1930) 21 600

Fricassées consist of small neat pieces of white meat in a flavoured white sauce made from the stock in which the meat was cooked with the addition of milk

Veal Fricassée

- 1½ lb veal fillet
- ½ lb ham
- 1 onion (small)
- 5 button mushrooms
- Bunch of herbs
- About ½ pint water
- 1 oz butter
- 1½ oz flour
- ½ pt stock
- ½ pt milk

Cut meat in neat pieces and cook in water until tender (about 1 hour). Adding vegetables flavourings and seasonings. Strain. Make sauce by adding flour to melted butter and pouring on stock and milk. Boil for 5 minutes. Add meat. Serve with crescents of fried bread rolls of bacon and lemon butterflied (qv). *Blanquette* is similar to fricassée but usually has 2 yolks of eggs added.

Friction, the force resisting the relative motion of two surfaces in contact. When the surface is an imaginary division in a substance the term internal friction or viscosity (qv) is used as with a liquid or gas. If the surfaces are solid and rough movement will result in considerable abrasion and the friction is then due to the resistance to breaking or tearing of the projections. A sharp distinction exists between the force required to start the relative motion of the two surfaces (static friction) and that required to maintain motion (kinetic friction) the latter as a rule being very much the smaller.

Kinetic friction according to Coulomb's law is independent of the area of the surfaces in contact and of the speed of motion but is proportional to a number called the *coefficient of friction* (a constant for any two materials) and to the force with which the surfaces are pressed together. The coefficient of friction between two materials can

be determined by measuring the angle which will just cause a block of one material to slide continuously downwards over a surface of the other material. The same arrangement enables the static friction to be determined also.

Approximate values of the coefficient of friction are: wood on wood 0.4 iron on iron 0.15 leather on metal 0.55 steel on ice (in skating) 0.05. The greater the difference in nature between the two materials the less the friction since molecular forces produce fitting in the case of similar material just as two racks having teeth of identical pitch interlock, whereas if their pitch is different they slide over one another. Hence it is a rule in engineering that surfaces of like

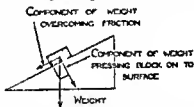


Diagram of force 1 g.o. a block situated on an inclined plane

material should never glide over one another especially if lubrication is uncertain. Steel arbors run in brass or aluminium bearings with much less wear than in steel bearings even a slight difference as between hard brass and soft brass will greatly reduce friction and wear. When two similar metallic surfaces are perfectly smooth and plane they may be wrung together that is pressed together with a sliding motion to exclude air. They then adhere strongly showing that in ordinary friction there is no real and extensive contact of the surfaces.

Rolling friction is the term applied to the resistance of the motion of a sphere or cylinder rolling on a surface. It is very much less than sliding friction. Use is made of this in ball bear-

ings and friction wheels. See also BEARINGS AND LUBRICATION, ENERGY. **Friedland, Battle of** (Napoleonic Wars) June 14, 1807. The Russians and Prussians under Bennigsen were routed by the French under Napoleon I and Lannes.

Friedrichshafen, town in Wurttemberg, Germany, on the NE shore of Lake Constance. The chief industries of the town are arship- and boat-building, leather, and motor-car making. The arship *Graf Zeppelin* was built here. The town is also a favourite tourist resort. It was founded by Frederick I, who joined the monastery village of Hofen, founded in the 11th cent, to the 9th-cent town of Buchhorn. There is a palace which once belonged to the rulers of Hofen. Pop 11,300.

Friendly and Benefit Societies, mutual associations for the purpose of insuring their members by money payments in times of sickness or other disability from work. Originally formed as independent societies, approved by the Friendly Society Acts of 1834, 1896, and 1908, they have now been constituted administrators of the National Health Insurance Scheme of 1912, although many continue their own voluntary work. It was calculated that there were 7200 friendly societies in existence in 1793, many being already over a hundred years old at the time. About 70 of them still exist to-day. In the early part of the 19th cent there grew up parallel with these societies various orders, of which the first was founded in 1810. These orders, with their lodges, passwords, and ritual, were at first purely benevolent institutions, but gradually worked out scientific insurance schemes which are the basis of their present operations. The best known are the Odd-fellows, with 750,000 members and £21,000,000 funds, the Foresters, with 550,000 members and £13,000,000 funds, and the Rechabites, with 600,000 members and £3,500,000. The orders work through their numerous branches, each of which has self-

government within the general regulations. Slightly different in character are the accumulating sickness societies, such as the Hearts of Oak, with 450,000 members and £11,000,000 reserves.

In 1846 a Registrar of Friendly Societies was constituted, and the Registry Office, founded in 1876, regulates the general affairs of the societies. Registered societies have certain legal privileges. Benefits are payable for sickness (10s-12s in the country, 15s-20s in London), and payments made on the death of a member of £12, or of his wife, £6. The weekly rate of contribution for such benefits would be 5d at 18 years old, 6d at 27, and 7½d at 35. In certain cases the insurance is combined with a personal savings scheme, thus being the particular function of the deposit societies, in which contributions are divided between the member's deposit and the common sickness fund. There are special benefit and relief societies for railwaymen, miners, warehousemen, and clerks. At the end of 1930 the voluntary membership of registered friendly societies was over 7,600,000, and their funds over £108,500,000. Annual expenditure on sickness is about 5½ per cent, and on death claims about 1½ per cent, of the total funds.

The Friendly Society movement is particularly strong in Australia, New Zealand, France, Belgium, and Denmark.

Friendly Islands, see **TONGA ISLANDS**. **Friends, Society of**, see **QUAKERS**.

Friesland (*Friesland*). Dutch province N of the Zuider Zee. It is low-lying, and drainage and sea encroachment are serious problems. Agriculture and dairy farming are carried on, and a famous breed of cattle is reared. There are no minerals, and no manufactures, the chief town is Leeuwarden, and others, scarcely more than villages, are Sneek, Franeker, Stavoren, and Bolsward. There are many lakes, including the Tjeukemeer and Slooter Meer, transport is mainly by canals.

Area 12.0 sq m pop (1931) 100 000

Frieze (FREZ) in architecture part of the entablature (qv) between the architrave and the cornice. In the Doric order the frieze consists of alternate triglyphs and metopes (qqv). Ionic and Corinthian friezes are architecturally plain but often richly decorated. Decorative friezes may be placed above the top of the wall of a building the most famous example being the frieze of the Parthenon most of which is in the British Museum.

Frigate, formerly a small swift Mediterranean vessel using oars or sails from the 18th cent onward a fast cruising war-ship three masted fully rigged and with 30 or 40 guns on a single deck. With the coming of ironclad steamships it developed gradually into the modern cruiser.

Frigate-bird, a fairly large s bird with a long hooked beak very short legs a forked tail and a wing-span as wide as a swan's. It is remarkable for its swiftness and grace of flight and its power of gliding for prolonged periods through the air without perceptible wing movement. In the throat the cock birds have a scarlet air-sac used in courtship display. Frigate birds which are related to pelicans and cormorants feed on fish captured as the bird skims along the surface of the sea but in addition they often force gannets to disgorge their food in mid air swooping down on the prey before it reaches the sea. They nest in trees making a rough nest of twigs for the single egg.

Frisian Islands, chain of islands stretching from the Irish coast N and E almost as far as the mouth of the Weser. They are divided into the W E. and N Frisians and are separated by shallow lagoons from the mainland of which they were once a part. Erosion is proceeding steadily huge areas having been lost during the past ten centuries. The people are occupied in fishing and the rearing of sheep and cattle. There are sheltered sandy stretches on the landward

shores which make popular holiday resorts. The W Frisians belong to Holland and the other two groups mainly to Germany.

The W group includes Texel (71 sq m) and Terschelling (41 sq m) the E group Borkum (12 sq m) and Norderney (6 sq m) the N group Sylt (39 sq m) Föhr (3 sq m) and Heligoland (1 sq m).

Frisians, a Teutonic race who dwelt in the maritime province between the R. Scheldt and Ems. In the 7th cent AD they were a powerful seafaring trading people. The Franks tried to convert them to Christianity by force and succeeded in breaking their power. The result was that there was no longer such a powerful check on the Scandinavian pirates in the Baltic and the Viking invasions of Europe followed the decline in Frisian power. Parts of Frisia remained independent until in 1475 the Emperor was acknowledged as overlord.

Fritillary several species of Nymphalid butterflies in which the upper side of the wings is bright brown with black spots and the lower side of the hind wing has silvery spots or bands. **Fritillary** is also the name of a genus of bulbous plants of the family Liliaceae. The species known as snakeshead grows in lush river meadows in S England.

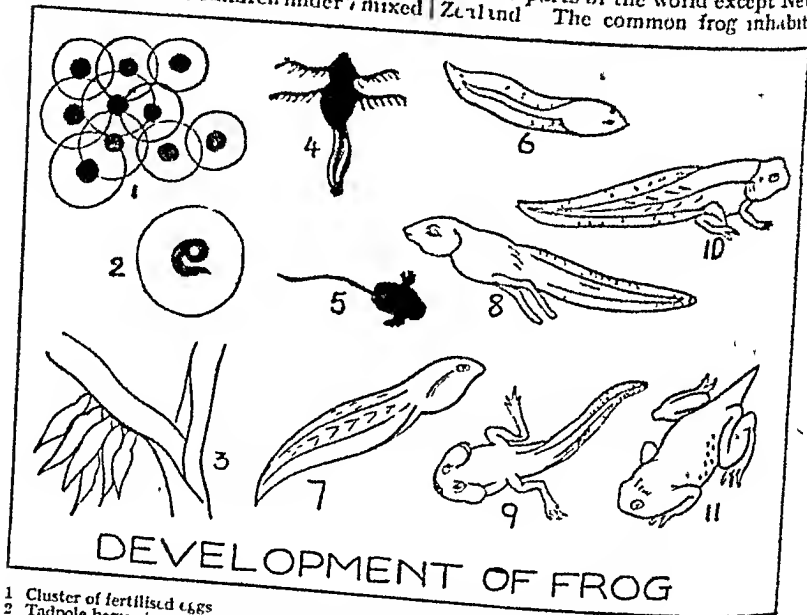
Fritters, see BATTER.

Frobisher Sir Martin (c 1535-1594) English explorer born in York. In 1576 he led an expedition sponsored by Dudley Earl of Warwick to discover the NW Passage to the Indies. In the following year he brought back gold from the neighbourhood of Frobisher Bay and repeated his journey a third time in 1578. He went with Drake to the W Indies in 1585 fought against the Armada in 1588 and was vice admiral to Sir John Hawkins in a harrying expedition in 1590. He was wounded at Brest in 1594 and died at Plymouth.

Froebel, Friedrich Wilhelm August (1774-1851) German educationist and founder of the kindergarten at

first a follower of Pestalozzi (p. 1), his ideas went much farther. Certain of his theories were considered to be revolutionary at the time, but their soundness has been proved by experience. He held that children should mix with other children from the earliest possible age, and for this reason established the first kindergarten (1827), where children under 7 mixed

(q.v.), but properly restricted to the family of which the common frog is a familiar example. In this family the upper jaw has teeth on the palate as well as on the edge, the tongue is deeply cleft, and the toes of the fore foot are not webbed. Frogs of this group are found in nearly all the warmer parts of the world except New Zealand. The common frog inhabits



DEVELOPMENT OF FROG

- 1 Cluster of fertilized eggs
- 2 Tadpole beginning to develop in egg
- 3 Bunch of tadpoles attached to water weed after hatching
- 4 Tadpole with fully developed external gills
- 5 External gills disappearing

- 6 External gills disappeared
- 7 Body thickening
- 8 Hind legs appearing
- 9 Hind legs developing feet, tail shortening
- 10 Front legs developed
- 11 Young frog with tail almost absent

with their fellows and were encouraged not to sit and listen to teachers, but to do various constructive tasks of their own free-will, the teachers merely acting as guides. Froebel also instituted training courses for women teachers. His methods both of training teachers and training pupils are still widely followed.

Frog, the popular name for a large number of species of tailless Amphibia

temperate Asia as well as Europe, living in damp situations near water, which is essential for breeding. During the winter these frogs hibernate, usually in the mud at the bottom of ponds, but in the spring they emerge and pair in the water, both sexes at that time uttering the familiar croaking. After spawning the parents leave the water and feed on land, eating slugs, worms, and insects of various

unds The spawn is a mass of black shaggy each enveloped in a gelatinous covering. The eggs hatch into tadpoles which have a globular head and body and a long tail but no limbs and breathe by gills. Tadpoles feed on water weeds and other vegetable food. During growth the tail and gills dwindle and legs and lungs are acquired. As tiny frogs they leave the water and it is not uncommon to find them still with small tails on the banks of ditches or ponds.

The life-history and habits of other species are very similar. The edible frog of the Continent is larger than the common species. It is found in some parts of England but was probably introduced. Considerably larger than either of these European frogs is the N. American Bull frog which is nearly 8 in long and large enough to swallow ducklings but the largest of all is the Goliath frog of the Cameroons which may exceed 10 in in length.

Frogbit, a floating aquatic plant with creeping stems roundish stalked leaves and delicate white flowers flowering in August.

Frohman, Charles (1860-1915) American theatrical manager assistant manager of Madison Square Theatre New York from 1879. Organised many touring companies in Great Britain. Drowned in the sinking of the *Lusitania* May 7 1915.

Froissart, Jean (c 1334 - c 1400) French chronicler author of a history of his lifetime. In 1356 he became secretary to Queen Philippa of England. He travelled about Europe gathering information for his history and visited England again in 1361 staying for five years. He wrote many works including a conventional love poem *Tout le monde aime l'espinette amoureuse* but his fame rests entirely on his *Chronicle*. This is a vivid work and a mine of information about a period which he saw too closely to be able to treat critically. It is the great expression of the spirit of chivalry.

Froude, Le, a rising of the citizens of Paris in 1648 against Louis XIV. It

attained considerable dimensions but was suppressed in 1652.

Frost, strictly a deposit of frozen water from the atmosphere but applied also to water vapour frozen mechanically. The deposit seen in the open takes the form of crystalline and granular hoar frost the latter being formed by the freezing of drops of water deposited from mist and the former from water evaporated from streams or lakes or from the water vapour which is always present in small quantities in the atmosphere. Hoar frost especially of the crystalline type forms beautiful patterns on vegetation or on window panes the pattern of the deposit on the latter varying slightly according as to whether the moisture is derived from the air in the room or from the outside air. Frost causes much destruction to rocks and strata as the water which has percolated into cavities expands in freezing. Vegetation too is liable to damage through the freezing of the sap contained in the plant especially in the early spring and autumn. Any process which leads to cooling of the surface of the earth and the adjacent air favours the occurrence of frost. Commonest causes are seasonal change and loss of heat by radiation.

Froude James Anthony (1818-1894) his tortoise is best known for his *History of England from the Fall of Wolsey to the Defeat of the Spanish Armada* (1855-60). He wrote many other historical works but in all of them his personal opinions and sense of the dramatic are emphasised at the expense of the facts and his work is therefore more interesting than reliable. He was a friend of Carlyle and wrote much regarding him. He also edited and published Carlyle's *Reminiscences* and other papers.

Fructose (*fruit sugar* or *levulose*) is a mono-saccharose (see CARBOHYDRATES) found in many fruit juices and in honey. It is a white crystalline compound with a melting point of 95°C and is levo-rotary. It is manufactured on an industrial

hydrolysis of inulin (*qv*) and is used as a food constituent

Fruit Preserving, see **CANNING**; **FOOD PRESERVING**

Fruit Pudding, see **SUET CRUST**

Fruits, Morphology of. Fruits are developed in the more highly evolved flowering plants in order to protect the seeds and to help disperse them when they are ripe. They are formed from the enlarged ovary, hence the number of fruits formed from one flower depends on the number of ovaries in the flower. Most flowers have only one ovary, but the buttercup produces a number of separate fruits termed *achenes*. The achene is a dry indehiscent fruit formed from one carpel, and containing one seed. *Geum* has an achene with a hook, and the fruit is dispersed by animals. Clematis achenes have a feathery prolongation, formed from the style, which aids in their dispersal by wind.

The fruit of all members of the *Compositæ* family is a *cypselæ*, which consists of two carpels, joined, and containing one seed, united to the tube of the calyx. The limb of the calyx sometimes becomes pappose, and remains attached to the fruit, as in the dandelion and thistle. The *samara*, or elm and sycamore fruit, is an achene with a winged appendage. The *nut* is a one-celled fruit, with a hardened pericarp. The *drupe*, the fruit of cherry, peach, plum, apricot, mango, walnut, nutmeg, date, is a succulent fruit covered by a pericarp consisting of three layers, epicarp, mesocarp, and endocarp, and containing, when ripe, a single seed. The fruit of the blackberry is a compound drupe. The *follicle* is a dry many-seeded fruit which splits down one margin. Follicles usually occur in threes or fives, as in delphinium and monkshood. The *legume*, or pod, is similar, but splits down both margins, it is the characteristic fruit of the Pea family. The *berry* is a succulent fruit, in which the seeds are immersed in a pulpy mass, such as gooseberry and currant. The *pome*,

seen in the apple, pear, quince, is a fleshy fruit with the calyx adherent. The *capsule* is a dehiscent, dry fruit formed of several joined carpels. The porous capsule is seen in poppy, and *antirrhinum*. In the scarlet pimpernel the capsule opens by a lid. The *siliqua* is the characteristic fruit of the Wallflower family, and consists of two carpels which separate from below upwards, when ripe. The fruit-bearing spike of the Fir, and Larch, is called a *strobilus*.

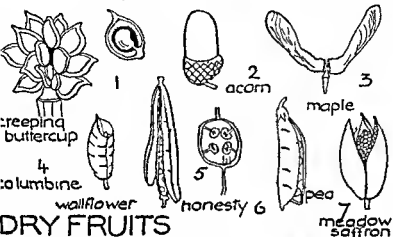
In *false fruits* the succulent part is formed partly or entirely from the receptacle, or top of the flower stalk. In the apple and pear the true fruit is the hard "core". The fleshy part of a rose hip is formed from the receptacle and encloses the true fruits, which are achenes. In the strawberry the achenes are embedded on the surface of the fleshy receptacle.

Fry, Charles Burgess (b 1872), English cricketer and all-round athlete, educated at Repton and Oxford, where he obtained his "blue" for cricket, athletics, and association football, represented Surrey, Sussex, and Hampshire at cricket, played for England against Australia 1899, 1902, 1903, 1909, and 1912, founder and editor of *Fry's Magazine*, author (with Beatrice Fry) of *A Mother's Son* (1907), hon. director of the Naval training-ship *Mercury*.

Fry, Elizabeth (1780-1845), Quaker and philanthropist. At the age of 20 she married Joseph Fry, and brought up a family of 12 children.

In 1813 she visited Newgate Prison and saw the appalling conditions under which prisoners existed. This experience led her to form an Association for Improvement of Female Prisoners in Newgate, consisting of 11 Quakeresses whose object was "to provide for the clothing, instruction, and employment (of the prisoners) . . . to render them docile in prison and respectable when they leave it". Neither did she stop at that, but took steps to enable male prisoners to be employed when they arrived in Australia.

FRUITS



DRY FRUITS

one seeded 1 achene 2 nut 3 samara
 many seeded 4 follicle 5 silique 6 lequme 7 capsule

SUCCULENT FRUITS

8 berry
 9 drupe
 10 cluster of drupelets

8 gooseberry
 9 plum
 10 blackberry

FALSE FRUITS

fruits enclosed
 in receptacle

11 apple 12 rosehip

fruits on outside of receptacle 13 strawberry

In her social reforming zeal she travelled in England, France, Germany, etc., visiting prisons. She even influenced reforms in Russia and Germany.

As a result of her campaign, in 1818 a Parliamentary Committee was appointed to examine the condition of the jails, the extent to which it was

by partial or complete immersion in hot fat. The former method is termed shallow frying, the other deep, or French, frying.

Foods suitable for frying

Meat Expensive cuts—rump and fillet steak, chops, cutlets, sheep's or lamb's kidneys, liver



Elizabeth Fry reading to the Prisoners in Newgate (From an Engraving by Borrell)

influenced by her advice is admitted in the Committee's report.

Fry, Roger Elliot (b 1866), English artist and author, was educated at Clifton and Cambridge, where he studied science. He was founder of the "Omega Workshops" for the production of *objets d'art* of various kinds and is the author of several important critical works among them *Giovanni Bellini* (1899), *Vision and Design* (1920), and *Henri Matisse* (1930).

Fryatt, Charles (1872-1916), British seaman, commander of a Great Eastern Railway Co vessel on the Harwich-Rotterdam route. Captured and executed by the Germans, 1916, on a charge of having attempted to ram a German submarine. Buried at Harwich.

Frying, a quick method of cooking

Fish Fillets, cutlets, smelts
Reheated foods Croquettes, rissoles, fish cakes.

Vegetables Mushrooms, potatoes, tomatoes

Puddings in small individual portions consisting of, or covered by, some farinaceous mixture, fritters, pancakes (doughnuts)

Preparation and Cooking Foods can be divided into two groups: (1) those which are fried without previous preparation, such as meat and eggs; (2) those which require a coating of egg and breadcrumbs, flour and water batter or pastry.

Shallow frying is used for meat and pancakes. Heat the fat until smoking hot, immerse the article of food, turning it frequently in order to brown both

sides. This is a wasteful method as the fat which remains cannot usually be used again. It is however a useful emergency measure.

Deep frying can be done in a pan specially made for the purpose about 7-8 in. in diameter and 4-5 in. high but a saucepan may be used instead. It should be fitted with a wire basket. The fat used may be olive-oil, other vegetable oils, dripping or lard. Olive-oil is expensive and lard tends to waste more quickly than dripping. About 3 or 4 lb. will be required for a pan 8 in. in diameter. Heat the fat until the bubbles cease, the surface becomes smooth and a blue smoke rises. The temperature of the fat is now suitable for frying (see COOKING TEMPERATURE CHART). Or it can be tested by dropping a 1 in. cube of bread into the hot fat. For uncooked mixtures it should brown in 1 minute—for cooked in 4 minutes.

Place food in the basket, a little at a time as large quantities will make the fat too cool. Turn if necessary. Remove and drain over pan and then on crumpled absorbent kitchen paper. Keep in hot place. Wait for fat to reheat to correct temperature before immersing next batch.

Care of Fat. After frying strain fat through muslin, wipe the pan, return the fat and store until required again. If the fat becomes dirty melt it, add $\frac{1}{2}$ teaspoonful salt and $\frac{1}{2}$ tea-spoonful soda to each lb. Pour boiling water over it and stir. The next day or when cold remove fat from top, scrape the bottom, remelt and allow to heat slowly until all the water has been drawn off.

Frying pans. Three types of frying pans are required in a household: one for shallow frying, one for deep and an omelet pan. A strong iron pan is the most suitable for ordinary household frying. It does not buckle with the heat and food is less likely to burn than in a thin aluminium one. A cover keeps the food moist and plumper, protects the top of the pan from spluttering fat and being

filled with fumes. A deep-fat frying pan is best made of aluminium as iron would be too heavy. These pans are supplied with a wire draining basket. Two projections of the pan on opposite sides form useful rests for the basket while the food is drying. A modern development of the deep fat frying pan is a rounded fat container which is fixed to the rim. Less fat is required and the food cooks more quickly for all the heat from the gas is entrapped inside the rim. An omelet pan should be of moderately thick iron or aluminium and have rounded sides. A smooth surface is important to prevent sticking. This should be ensured before using by *proving*. To prove an omelet pan heat a small quantity of lard until smoking hot, pour and rub round with paper.

Fuad I King of Egypt (b. 1868) son of the Khedive Ismaïl Pasha, succeeded his brother Hussein as Sultan (1917) and became king when the British protectorate ended (1922). After the crisis of 1927 he suspended the Constitution but restored it two years later. He visited England in 1927 and 1929. He is the founder of the Egyptian University.

Fuchsia, a beautiful plant of the natural order Onagraceae: it has erect much branched stems, smooth rather thick pointed leaves and drooping heavy flowers borne singly in the axils of leaves towards the end of branches. The flowers have coloured fleshy calyx and tubular corolla usually of different colours or shades of the same colour and long deep-purple filaments bearing cross-set anthers. A few species are hardy and may be grown in rich soil in a sheltered and well-drained position with the protection of dry litter or leaves over the roots in winter. Others grow well out of doors in summer and are kept in a greenhouse Sept.-June. Propagation is by cuttings set in sandy soil in May.

Fuchsine, an artificial dye also known as magenta, rosein, harmaline and aniline red, obtained by the reduction of a mixture of nitro-benzen

aniline, and toluidine. Fuchsin itself consists of green crystals which in solution dye textiles red. It can be used directly on to silk and wool and, with a mordant, on to cotton. It is, however, not fast to light.

Fuego, Tierra del, *see* TIERRA DEL FUEGO

Fuel Oil, a dark and heavy residue obtained from the distillation and cracking of petroleum. It is employed in the unpurified state as a boiler fuel both for ships and for land installations. Its low cost and ease of handling (by means of pipes), together with the fact that it can be ignited without delay and gives a very hot flame, make it a serious competitor for coal, which it has already succeeded in displacing in many fields. The usual method of burning the oil is to discharge it by means of compressed air through a special nozzle placed in the fire-box. In thermostatically controlled heating installations the oil-jet is lit by an electrical device. There is no definite grading for fuel oils, since almost any petroleum product may be used as fuel. Although, as stated above, fuel oils are generally residual products, some of the higher grades may be distillate products, and would even be suitable for use in an internal-combustion engine of the Diesel type.

Fuels. A fuel is a combustible solid, liquid, or gas, which is made to combine with the oxygen of the air in order to generate heat. The value of a fuel, therefore, is expressed in terms of the heat units which can be obtained by burning a certain weight of it, this being called its *calorific value*. A fuel is bought and sold largely on the basis of its calorific value, but, especially in the case of solid fuels, other qualities also need to be taken into account.

The calorific value of *wood* (chiefly cellulose and ligno-cellulose) is low, being about 3500 calories per gramme, but wood, where it is plentiful and no other fuel is available, is nevertheless important.

Peat is a brown or black substance found on the surface of the earth in many parts of the world. It results from the accumulation of successive layers of dead vegetable matter, which is prevented from decomposing by being swamped by water. When taken from the bog it contains up to 90 per cent by weight of water, and the elimination of this water is the essence of the problem of utilising the vast peat deposits of Ireland, N. Germany, and other parts of the world. By air-drying the water content is reduced to about 50 per cent, varying with the season of the year, but this process is excessively slow. Some of the water can be squeezed out by mechanical pressure, and much can be got rid of by electrodialysis (*qv*), but there always remains a residue after all these processes, the peat being essentially a gel structure (*see* COLLOID CHEMISTRY). This structure may be destroyed by heating the peat, and the water can then be removed by pressure, but in spite of the fact that large sums have been spent on research work on this subject, the utilisation of peat on a large scale has never been really successful.

The next stage in the formation of ordinary coal is *lignite*, or brown coal, which is denser and darker than peat, and contains less water. The calorific value rarely exceeds 6000. It is hardly known in England, but is used all over Germany as a domestic fuel in the form of briquettes, and it is extensively utilised for the generation of the electric power which is supplied to the German grid-system.

Bituminous coal is by far the most widely used fuel, and is characterised by the production of much smoke in burning, the result of the imperfect combustion of volatile substances given off as the coal is heated by the fire. This serves to distinguish two separate types of coal, the caking and the non-caking, so called according as they do or do not melt and cake together when exposed to a moderate heat. Non-caking coals cannot be used

to form a coherent coke. See also COAL GAS-MAKING.

The ash of coal is only partially contained in the coal substance, the greater part of it as a rule runs in layers of various thickness through the seam. These layers represent mud and silt deposited along with the original vegetable matter and then subjected to heat and pressure. The ash-bearing substance often called shale usually contains about 20 per cent. of combustible matter while the pure coal may contain as little as 1 per cent. of non-combustible matter. It is of great advantage to clean the coal by removing the ash-bearing constituents. This involves breaking up the coal and treating it by one of the methods employed in ore dressing (q.v.) that principally used being wet jigging and

tabling in various forms, in which the mixture is agitated with water, the shale particles collecting at the bottom of the mass or separating as the mass passes over a vibrating table. Dry processes depending on agitation by air currents are coming into use as well as flotation which is now the most important of all methods of ore dressing. The grave disadvantage attaching to all these methods as well as to the handling of coal which in most cases is a soft and friable material is the production of fines and slack which are difficult to utilise for firing. These and other considerations are leading to the rapid introduction of means by which the coal is blown into the furnace in the form of very fine dust, which is usually prepared immediately before use in order to avoid the danger of storage, coal dust mixed with air being explosive. Various systems of burning pulverised coal are now completely successful but all have a new drawback, namely that the ash, which can never be completely removed, escapes in the form of dust so fine that only electric precipitation will remove it. On the other hand the method completely abolishes the nuisance and waste caused by the production of black smoke though it does not

lessen and perhaps even aggravates the formation of sulphuric acid from sulphur contained in the coal.

Another method of using fines and slack consists in *briquetting* the pulverised material being mixed with pitch or tar and moulded under pressure. The process is cheap and very advantageous from the point of view of cleanliness and economy.

Coal dust fuel comprises a suspension of finely ground coal in fuel oil, the mixture being sufficiently fluid to be pumped and burnt as a spray. It can be stored with perfect safety, the only difficulty being the need to prevent the settling out of the coal during storage and in the pipe lines.

Anthracite is the final product of the process by which vegetable matter becomes coal. It is very dense and usually low in ash and the content of carbon may be as high as 85 per cent. or more. It is very widely used for domestic fuel and also technically. It is employed in metallurgy also.

Coke (q.v.) is a fuel of great importance, the only disadvantage being the fact that it is difficult to ignite and must be maintained at a high temperature. There are three kinds of coke: metallurgical coke, gas coke and low temperature coke. Metallurgical coke is the hardest and densest as it is produced at the highest temperature as a result of this the coke-oven gas evolved is unsuitable for town use but the coke made in the course of the manufacture of town gas is too soft and friable for use in the blast furnace where the weight of the charge would crush the lower layers to a compact mass which would not admit air. Gas coke is much used as a domestic fuel particularly for firing central heating plant.

The conversion of coal into coke before burning is economically an advantage since it enables many valuable by-products such as coal tar, compounds, oils and ammonia to be recovered. The lower the temperature at which carbonisation takes place the more perfectly is this advantage

attained Hence the great efforts made to develop low-temperature carbonisation, which has the further advantage of yielding a coke which burns readily and with the evolution of much heat in the ordinary English domestic grate Since, however, the use of the latter is almost confined to Great Britain, low-temperature carbonisation has made slow progress

Petroleum (qv) is a fuel of increasing importance It needs to be freed from its more volatile natural constituents, owing to the risk of explosion The ease with which it can be handled, the absence of ash and smoke, the low labour costs of stoking, are all leading to a rapid increase in its use

The production of oil from coal has recently given promise of a large extension, owing to the improvement in the hygenation process, and the determination of Imperial Chemicals to establish a plant to cost several millions It is suggested that twenty or thirty plants may be built in various parts of the country and that perhaps the whole of the country's oil needs may be supplied by oil from British coal, and the use of raw coal for fuel almost eliminated

Gas (qv) is a most important fuel both for domestic purposes and in many technical processes where a "clean" heat is necessary, as in glass-making and ceramic work The various kinds of gas and their methods of production will be found referred to under *GAS*, and their mode of application under the heading *FURNACES*

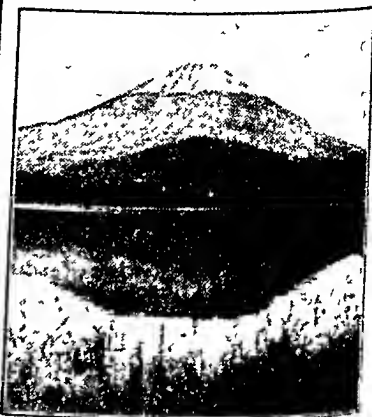
Natural gas occurs in America and Russia along with petroleum It escapes from the earth, often under great pressure when a boring is made, through the impervious strata which confine it Many towns in America are supplied with it See also *Industrial Chemistry*, by A Rodgers (London, 1925)

Fuentes d'Oñoro, Battle of (Peninsular War): May 3-5, 1811, one of the most hotly contested battles of the war Massey, on his way to relieve Almeida, attacked Wellington, but

failed to capture the position, and retired in good order Wellington's somewhat doubtful victory secured the evacuation of Almeida

Fugue, see *MUSICAL TERMS*

Fujiyama, a famous Japanese mountain 65 m W S.W of Tokyo It is a quiescent volcano, noted for its conical



Mt Fujiyama reflected in the waters of Lake Shoji

form It is a favourite subject in Japanese painting, and is visited by pilgrims for its religious significance Height 12,400 ft

Fu-kien, a S Chinese maritime province between Kwang-tung, and Chekiang, bounded on the E by the F Sea The surface is hilly, and the considerable heights along the W. border have separated it in language and customs from the interior Fu-kien is watered by the Min and other streams, and the valleys are extremely fertile Two crops of rice a year are usually produced, and large areas are under tea, the province being noted for a flower-scented brand There are large forests and the timber output is one of the largest in China Other produce includes cotton, sugar, tobacco, and indigo The chief industry is paper-making from bamboo pulp The mineral resources—coal, copper, graphite, iron, and gold—have not been exploited The principal towns

are Foochow (qv) the capital and Amoy Area 46 500 sq m pop c 14 330 600

Fukuoka, Japanese town near the N W coast of Kyushu 1 land 80 m N E of Nagasaki It is a great silk weaving centre and enjoys a large general trade At Hakata an adjoining city is a huge bronze head of Buddha Pop (1930) 218 300

Fulgurite a rock whose surface has been melted by the action of lightning and on which the fused material has re-solidified as a kind of thin coat of varnish

The term is also applied to tubes produced in rocks chiefly in loose sandy beds by lightning

These tubes are up to 2½ in in diameter and rapidly narrow and disappear in the rock They represent the path melted by the electric spark and may be lined with a kind of glass formed from the melted rock

Fulham, metropolitan borough W of Chelsea Local industries include brewing wall paper manufacture and engineering The most important buildings are the Bishop of London's palace which stands in fine grounds not far from Putney Bridge and Queen's Club The manor originally known as Fullanham is believed to have been in the possession of the Bishops of London from the 7th cent Pop (1931) 150 940

Fuller John Frederick Charles (b 1878) British soldier and tank expert After serving in the South African War and the World War he was appointed chief of the Tank Corps (1917) The tank successes at Cambrai and afterwards were attributed to him and on the establishment of mechanical brigades (1919) he was appointed military assistant to the Chief of Imperial General Staff Author of *Tanks in the Great War* and *Foundations of a Science of War* (1916)

Fuller Thomas (1608-1661) historian author of *The Worthies of England* was a Royalist chaplain during the Civil War He wrote *Holy State* and (1641) *Good Thoughts*

in *Bad Times* and *Better Thoughts* in *Horse Times* his works also include a history of the Church and an account of the Holy Land His style is witty and humorous and much emotion is infused into his accounts of past events

Fuller's Earth a mineral of a character similar to ordinary clay as regards its composition but not plastic It is greenish or brownish and crumbles into mud when in contact with water It consists of exceedingly minute grains which have a strong power to absorb oil and grease and particularly colouring matter contained in these It is found in all parts of the world though its composition varies greatly Before the invention of dry-cleaning it was very much used for cleaning fabrics owing to its power of uniting with greasy dirt It is now chiefly used for purifying oils and for loading paper It is also used as a cooling and absorbent powder and as the basis of several cosmetic powders

Fulpulver see EXPLOSIVES

Fulmar the largest of the petrels (qv) of the North Atlantic about the size of the common gull and like it in general whiteness of plumage The fulmar is a valuable bird on account of its oil which is as nutritious as cod liver oil To the inhabitants of St. Kilda the bird was an important item of food supply thousands of the young birds being collected in a season to be eaten after the oil had been extracted

Fulminate of Mercury see EXPLOSIVES

Fulminates the metallic salts of fulminic acid HCNO They can be made by dissolving a metal in strong nitric acid and adding alcohol the fulminate is then precipitated The fulminates are highly explosive compounds used for the manufacture of detonators (qv) The principal fulminates of industrial importance are those of mercury and silver The latter is responsible for the bang in Christmas crackers

Fulton Robert (1622-1697) neer born in

to London to study drawing under Benjamin West, but turned to science and after much work upon river and canal navigation invented a submarine, which was tested by both the French and English Governments. In 1806 he returned to America, where he spent the remainder of his life in 1807 building the first successful steamboat.

Fumaroles, clefts or funnels associated with volcanoes and through which gaseous material emanates.

As a volcano cools after an eruption the type of vapours given off varies. The hottest vapour contains no steam, the next stage contains steam with sulphurous and hydrochloric acids, the next, at a temperature of about 200°F, steam and ammonium chloride vapour, and finally in the last stage pure steam, with carbon dioxide and sometimes sulphuretted hydrogen.

Fumaroles showing each particular stage of this are respectively called dry, acid, alkaline, and cold fumaroles.

Fume Precipitation, one of several terms applied to the removal of finely divided solid or liquid particles from air or other gas. This problem is one which tends to become more acute as industry progresses. In high-speed grinding, the firing of pulverised coal, and many other cases of large-scale industry, it may be imperative to remove dust from air in order to avoid danger to health. An appliance of a simple character is the *bag filter* as used in the ordinary household vacuum cleaner. Another device, the *cyclone separator*, is effective only when the substance to be removed is not too fine. It consists essentially of a cylindrical vessel, having a conical taper at the bottom, the air enters at the circumference tangentially and leaves by an outlet in the axis of the cylinder. It thus whirls round in the cylinder several times, and the particles of dust are precipitated by centrifugal force.

The most effective apparatus, and one rapidly coming into extensive use, is the *Lodge-Cottrell electric precipitator*. The principle consists in producing in the gas a high-tension direct

electric field between two electrodes, one of which is armed with numerous fine points, the other being smooth. Usually the brush electrode consists of a strand of wire with the necessary brush material, which may be fine wire, twisted in it, passing round the axis of a tube. The phenomenon is known as the *electric wind*, an ionisation of the air under the concentrated field at the sharp point, and its repulsion therefrom, is produced. At the same time uncharged dust particles are attracted to the sharp points, charged by contact, and then repelled with the air, being thrown down on the smooth tube, from which they fall in a more or less coherent form. Unfortunately, although it is not excessively costly when the material recovered has any value, its use on ordinary chimney fume from furnaces appears to be uneconomical.

Fumigation, the process of disinfection and killing of insects and vermin by the exposure of the infected and polluted materials to toxic fumes. The term is also applied to the curing of foods by exposure to wood smoke, and to the seasoning of woods by the same method. The principal agents used for sanitary fumigation are sulphur dioxide, hydrocyanic acid, and formaldehyde. The use of hydrocyanic acid is almost entirely restricted to ships and isolated buildings, such as warehouses, on account of the highly poisonous nature of the gas. For the destruction of insects there are several gases available that are toxic to insects but not very harmful to man, such as ethylene dichloride. An interesting development in fumigation for the destruction of insects and vermin is the addition of about 5-10 per cent of carbon dioxide to the fumigant gas. This stimulates the breathing of the animals to be destroyed and thus ensures the more rapid absorption of the toxic gas. See also **DISINFECTANTS**.

Fumitory, name of several species of herbaceous plants of the family *Fumariaceæ*, akin to the poppies. Fumitories are mostly found in tem-

climates. Five main species d in two genera *Fumaria* and *Asperula* occur in Britain. They are little stems which exude a milky juice when broken and are climbing plants. The Common *Asperula* however grows erect and has blue-coloured flowers tipped with white.

It grows on waste land and in hedges or cornfields bears cream-coloured flowers. The *Asperula* is a long slender plant growing in hedges and bearing small white flowers. Two other species bear purple and yellow flowers respectively.

Funchal, capital of Madeira, is the most popular holiday resort (Madeira) is the chief export of agriculture mainly sugar-cane which is widely carried on in the valley. Funchal is the chief commercial centre for the produce of the island and has a busy harbour trade.

4250
Fundamentalism, general name for religious movement in many countries. Protestant sects in favour of literal inspiration of Bible. It has developed especially since the World War and is especially strong in the Middle West.

Much attention was drawn to the case of a Tennessee teacher for upholding the doctrine of evolution in a school.

During the conversion of floating short-term debt (q.v.) into long-term debt or bonds. The process may be undertaken by Governments, municipalities and even large commercial companies which from time to time raise an issue of debenture or stock issue to all outstanding notes, bills and debentures. While the total indebtedness is not reduced, the rate of interest payable is usually much lower, especially if funding is carried out at a favourable time. In periods of low interest Government and municipalities content themselves with

Fundy Bay of a bay in the North Atlantic Ocean between New Brunswick and Nova Scotia c 130 m long and 35 m in average breadth. It narrows into the Chignecto and Minas Channels. High tides rise to a bore of 50 ft in Minas Channel.

Fünen, a large Danish island between Zealand and Jutland. It is well wooded and fertile. Large herds of cattle are raised and cereals grown. The chief towns are Odense and Svendborg (see DENMARK). Area c 1350 sq m. Pop 340 000.

Funeral Rites see RELIGION PRIMITIVE

Fungi a group of lowly plants many of which are visible only under a microscope while others form big fruiting bodies such as the mushroom, toadstools and bracket fungi. None possesses chlorophyll so that it cannot make its own starchy foods from water and carbon dioxide but must obtain all the necessary nutriment from other living or dead organic matter or from the excreta of living bodies.

The fungi are classed as plants although they have no chlorophyll because their bodies are either unicellular or composed of a number of cellular long threads of protoplasm in walls of a substance closely allied to cellulose which is the typical material of the walls of plant cells. Further the fungi show many resemblances to the algae (q.v.) the most primitive group of living organisms which are distinctly plants and not animals and they are believed to be derived from algae by loss of chlorophyll and other specialisation.

Reproduction is by spores produced both asexually and sexually and sometimes by the formation of single resting spores from vegetative cells. The individual spore of any type is at first a single cell with clear contents but the contents may become divided by cross walls or develop oil globules or become deeply coloured. Asexual reproduction in the fungi is quite distinct from that which in ferns and mosses alternates regularly with

asexual process to give rise to successive dyloid and haploid generations, with corresponding alternation of vegetative form

Physiology The majority of fungi are saprophytic, i.e. able to live on dead organic matter. Many of the most primitive fungi are aquatic, and grow on fallen leaves and twigs where the water contains sufficient oxygen. Many fungi are saprophytic on wood, and are able to destroy liquefied tissues, but while some decompose fallen tree trunks, branches, and twigs, and restore their material to the soil, others do serious damage to timber (see DRY ROT). The soil fungi, almost confined to the first 6 in. of soil, use amino-acids from decayed animal matter as a source of nitrogen, and some actively decompose cellulose. The "fairy ring" of darker grass in poor pasture is caused by a fungus whose branches spread outwards from the centre of infection, and at their advancing margin set free ammonia compounds which bacteria convert into nitrates, enriching the soil and causing lush growth of the grass. The coprophilous species belong to many different genera and have striking adaptations to their habitat, such as mechanisms for the projection of spores to a distance, towards light and open space, they are ejected on to grass, eaten by cattle and germinate after passage through the intestines of the animal. Other fungi grow on fats and oils, some of these are used in ripening cheese. Others cause the brown furry mould on bread and preserves. Yeasts can break up carbohydrates in solution into alcohol and carbon dioxide, release energy for growth, and may be used economically both in baking, where the carbon dioxide causes the bread to "rise," and in brewing.

A number of other species of fungus are parasitic, either *facultative parasites*, which can live equally well on dead or living organisms, or *obligate parasites*, which are found only on living material and die when the host is killed. Mildews, rusts, and many other pests of

wild and cultivated animals and plants even some causes of disease in man, are parasitic fungi. Many forest trees always have some particular fungus in intimate association with their roots, forming a close sheath of microscopic hairs over the rootlets, and the fungus is believed to live in symbiosis with the tree, itself absorbing water and minerals which it passes on to the tree in exchange for carbohydrates. Orchid seeds will not germinate except in soil infected with fungus, which penetrates the seed and probably induces some chemical change necessary to release the energy for germination.

Classification This is primarily into two groups—the Phycomycetes or Algal Fungi, and the Eumycetes or Higher Fungi. Each is subdivided according to the development of the vegetative and reproductive structures. The Phycomycetes are the more primitive group, and include the aquatic fungi. The higher fungi are divided into Ascomycetes and Basidiomycetes, according to the form of their characteristic sporangia or spore capsules. In the Ascomycetes, the sporangium is an elongated, cylindrical body containing 8 spores, in the Basidiomycetes the spores are budded off from 4 points at the apex of a club-shaped cell.

Edible and Poisonous Fungi Contrary to the usual belief, the majority of toadstools are edible, some people, however, cannot eat fungi of any description without discomfort. Many fungi are poisonous until cooked, all are indigestible if not properly cooked, and no fungus should be eaten if at all mouldy or attacked by insects.

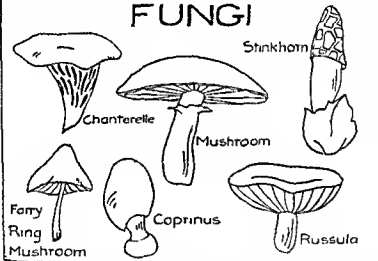
The belief that the poisonous or non-poisonous nature of a fungus can be ascertained by its peeling, by its taste, by its having been nibbled by rabbits or slugs, by the blackening of a silver coin or spoon is complete nonsense; the only way in which to know whether a fungus is edible or poisonous is by being able to distinguish it in the same way as other edible plants are.

distinguished and by learning its record. To help in this identification fungi are classified by the colour of their spores, the presence or absence of a ring on the stem or of a volva (the remains of a cuticle enclosing the whole fungus on its first appearance) at the base of the stem. The colour of the spores may be ascertained by placing the cap of the toadstool on a piece of paper for some hours when the spores will be found to have been projected in a pattern on the paper.

rubescens) Most conspicuous among the poisonous species is the *Fly agaric* (*Amanita muscaria*) noted for its brilliant red warted cap and for the fact that it grows near birch trees.

Of edible fungi the *Cap* (*Boletus edulis*) is well known on the Continent and is sold dried in Soho. Many other *Boleti* (a genus which differs from *Amanita* and from the common mushroom by having spores under the cap instead of gills) are also edible and delicious. The *chanterelle* a fungus

FUNGI



Figs 1 to 6 (no p. Back) only 1 to 6.

Most of the poisonous species are found among the genus *Amanita* which has white spores and both ring and volva. The persistent white gills of this genus distinguish it from the common mushroom. The death cap (*Amanita phalloides*) has been responsible for over 90 per cent. of the deaths caused by fungi and inflicts not only death but terrible agony. Some other species of the *Amanita* genus are almost as bad though yet others are edible (e.g. the blusher *Amanita*

with irregular gills and of an orange colour growing near fir or pine trees is also favoured. Of bracket fungi growing on trees the only one favoured—as most are leathery—is the *vegetable beefsteak* (*Fistulina hepatica*) which is red and grows on oak trees.

Some toadstools such as the fairy mushroom which grows in the well-known rings can be dried for future use but others putrefy. There are many ways of cooking fungi and the method must depend on the species.

but the result will always be satisfactory if the fungus is slowly stewed in milk until most of the moisture has been driven off, and then gently fried in butter with pepper and salt. Puff-balls, delicious if perfectly fresh, can simply be fried to a golden brown in bacon fat. Care must be taken not to confuse the evil-smelling and thick-skinned *scleroderma* with the various edible puff-balls which grow both in soil and on trees.

See *Handbook of the Larger British Fungi*, by John Ramsbottom (Natural History Museum).

Fungus Midge, small delicate, mostly gnat-like flies, so called because the food of the larvæ is usually fungi of various sorts, though some feed on decaying vegetable matter of many kinds. Crops of mushrooms are frequently devastated by them.

Funicular Railway, a railway for transporting passengers up a steep incline. It often runs on the principle of balance, two carriages of equal weight being joined by a long cable which passes over a pulley at the upper end. Small power is required at the pulley to bring one car up the slope, while the other descends. The system can be applied only to small distances—the sea-cliff at Douglas, Isle of Man, and small slopes of the Swiss Alps. A funicular system is suggested at Gibraltar, from the shore to the central peak.

Fur, see **HAIR**, **FUR-BEARING ANIMALS**, **CLOTHING**, **CARE OF**.

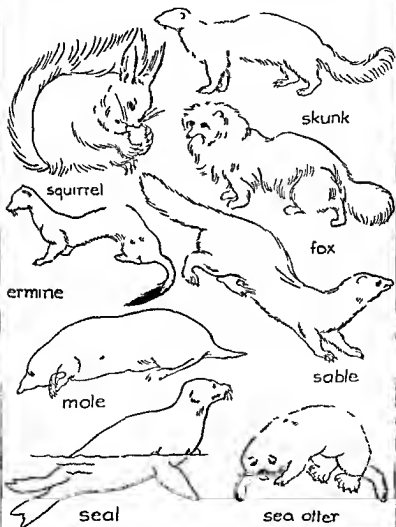
Fur-bearing Animals, mammals whose tanned skins, with the coat in its natural state or with the long hairs pulled or clipped, are used as rugs or worn for use or ornament. Strictly, the term "fur" should be restricted to species having a soft full coat, but recent fashions of wearing almost all skins have extended the term to some animals, such as certain tropical wild cats or common house cats, in which the hair is smooth and short, or even to the skin of the Indian civet cat, which has coarse hair redeemed by its mottled pattern. The best furs are furnished by animals living in Arctic

or cold temperate latitudes or high altitudes, where they grow a thick fur in winter, and by aquatic species, which, even in comparatively warm countries, have a close soft underfur to keep water from the skin. To these latter belong the fur-seals, the otter, beaver, nutria, and musquash or muskrat, in which, except in the muskrat, the long hairs of the coat are "pulled," leaving the underfur exposed. The most extensively worn furs of the first category are yielded by foxes, skunks, sables, and other species of martens, polecats, known in the trade as fish, and, formerly, ermine and lynxes. Skins of larger Carnivora, like Wolverines, wolves, bears, tigers, lions, and leopards, are usually made into rugs, but leopards and snow leopards are sometimes worn as wraps. The white hairs of the American badger are often stuck into the coat of black-dyed ordinary foxes to imitate the valuable silver fox. Squirrels and hamsters amongst the rodents are often used for lining cloaks and overcoats, but the most generally useful of all rodents is the rabbit, called coney in the trade. The skins are of good quality, cheap and abundant, and are made up to imitate all sorts of more valuable furs. Fancy rabbits are largely used for the supply, but cargoes of "natural" rabbits are shipped from Australia. Of the native Australian animals, the commonest furs are those of the wallabies and opossums, and formerly of the koala and the duckbill, but these two species are now strictly protected on account of their scarcity.

Although the fur-trade has brought some species to the verge of extinction, it is surprising how most animals are holding their own, thanks to close seasons, although thousands, even millions, of their skins are annually on the market. In the last quarter of a century fur-farming has become a profitable industry, and foxes, skunks, nutrias, and musk-rats have been imported to England and Europe and bred successfully.

Furfuraldehyde (*Furfural*, *furfural*,

FUR-BEARING ANIMALS



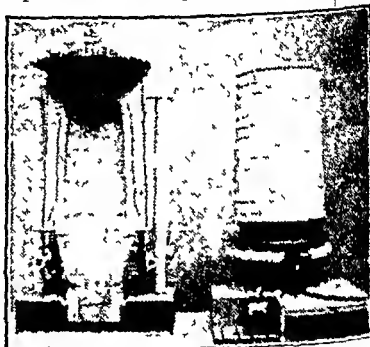
fural) is in the pure state a colourless liquid with a characteristic odour. The boiling-point is 162°C and the melting-point -35°C . On exposure to air furfural acquires a reddish colour, and it is never met with commercially in the colourless condition. Furfural can be obtained by the acid hydrolysis followed by the distillation of any material containing pentosans, in commercial practice the materials usually employed are corn cobs, oat hulls, and sunflower-seed husks.

Furfural is used as a solvent, and also for the manufacture of numerous synthetic resins, since it forms a large number of condensation products with such materials as phenol, urea, etc.

Furies, The, in classical mythology the ministers of divine wrath and vengeance, also known as the Eumenides, Erinyes, and Diræ. Wars, plagues, and the pangs of remorse were caused by them, and they had command over the torments of hell. Their names were Tisiphone, Megæra, and Alecto. They are represented with hideous faces, with snakes turning about their heads instead of hair, each holding a torch and a whip of scorpions and followed by demons. They were specially concerned with parricide, perjury, and offences against the laws of hospitality.

Furnace Probably the first stimulus to the building of furnaces of modern type came from the glass industry, which developed in Venice in the 13th and 14th cents. In the 16th cent the manufacture of wrought iron and steel from cast iron was evolved, since which time the *blast furnace* has been continually increasing in size. The blast furnace is a development of the kiln which, as the means of making lime for building, is extremely ancient. It belongs to the type called the shaft furnace, and consists simply of a vertical shaft into which a mixture of fuel and material is fed at the top, the desired product being withdrawn at the bottom. Kilns are described in the article CERAMICS, and the blast furnace in the article IRON AND STEEL.

Those parts of furnaces which are exposed to a high temperature require to be made of "refractory" materials, or refractories. Since these are liable to attack by the materials under treatment, their composition is of importance. *Basic refractories* consist of oxides of metals such as lime and magnesia, *acid refractories* contain a large amount of silica, either in the form of sand or flint, or combined as fire-clay. Fire-brick, the strongest and most generally useful refractory, is acid in character. Silica bricks, which are extremely infusible, are mechanically unsatisfactory. They expand under long continuous heating.



Sectional Model of a Blast Furnace

and are friable. Among basic refractories, the most useful is calcined dolomite, a mixture of magnesia and lime, moulded into bricks under pressure. Magnesite, magnesium carbonate, now made into a very satisfactory material containing only magnesium oxide and bauxite, a hydrate of iron and aluminium, makes excellent basic refractory bricks. Graphite, carborundum, and chromite are the chief neutral refractories.

The *reverberatory furnace* consists of three parts—a fire-box in which combustion of the fuel takes place, a hearth upon which the material to be heated is placed, and a chimney by which draught is created. The hearth is covered by a roof which is highest

near the fire box and slopes downwards thereby reflecting or reverberating the flame on to the material. In many cases the reverberatory furnace cannot be used because it brings the substance melted into contact with the furnace gases which may contaminate it. In *muffle furnaces* this is avoided by heating the furnace chamber from the outside.

The type of furnace (described in the article GLASS) in which the fuel used is gas—and the conservation of heat is effected by regenerators or recuperators—is employed nowadays wherever possible.

Artificial draught for furnaces is created by some form of blower (*qv*) the most useful being the centrifugal fan. For fuel see articles FUEL, GAS, INDUSTRIAL MANUFACTURE AND USES OF.

See A. Hermansen *Industrial Furnace Technique* (London 1939).

Furnace Electric see ELECTRO-CHEMISTRY.

Furness a part of Lancs detached from the rest of the county by Morecambe Bay and adjoining Westmorland and Cumberland. The N part is mountainous and forms part of the Lake District. The valuable beds of iron ore (haematite) to the S and W led to the growth of Barrow in Furness by far the largest town in the district. Furness Abbey 3 m N is a well preserved red sandstone ruin mainly in the Transitional Norman style. It was built by the Benedictines in 11-7 (see ABBEY). The highest mountain is Conistone Old Man (633 ft). The chief rivers are the Duddon commemorated by Wordsworth and the Leven the outflow of Windermere.

Furnishing the purchase and arrangement of furniture. Choice to-day is so wide that utility need not conflict with good appearance in any type of room or house. Furniture must be chosen with regard to the size of the room it is to occupy. A small room appears large by using fairly low furniture preferably light in colour and not over

crowded. Small upholstered or bergère suites, chairs with upholstered back and seat and good armchairs and framing. For restricted space special furniture is designed. The more individual pieces are not prohibitively expensive. The cheapest method of furnishing a room adequately is to buy second hand pieces or even antiques (see INTERIOR DECORATION).

Modern furniture relies for beauty on the natural wood and good design and continued wax polishing gives a hard surface practically impervious to stain. Walnut veneer is much favoured for figured effects. Oak is often treated by a weathering process including fuming with ammonia to give a grey colour. Lined oak light brown showing white in the grain is less popular. Mahogany is still extensively used and will doubtless return to full favour. The rarer cherry, eucalypt, ebony, Indian laurel, burnt elm etc. used in more expensive furniture deserve study by those interested in beautiful woods. Painted furniture must be of good quality. Unseasoned wood will give trouble. Enamelled furniture for the nursery is of practical design and can be washed. Metal furniture one of the latest innovations has greatly improved in design since its introduction from the Continent a few years ago. Durable, easy to transport and clean it has a comfort often belied by its looks. Stainless and cellulosed steel and chromium plate are used in conjunction with painted, lacquered or polished wood, plate glass and upholstery.

Sectional furniture designed on modern lines is growing in popularity. Each piece is complete in itself but two or more units may be assembled with all the appearance of a uniform whole. A dressing table for example may consist of two pedestals with drawers and a mounted cheval glass in the middle or a narrow tallboy standing at the side of a small table fitted with a mirror. Book-cases can be assembled together or arranged in conjunction with writing table or other

suitable piece, and a cupboard can be flanked on either side by book-case sections. The possibilities of arrangement are almost endless.

Dual-purpose and bed-sitting-room furniture includes almost every type of disguised bedroom furniture. Pieces resembling a cupboard may house a bed. In some cases the doors fold back from the middle, one forming the head-board, and the bedding is let down by unbuckling straps which keep it in position during the day. Divan, settee, and arm-chair beds are variations. A wash-stand not in use may appear as a small cupboard, the front opening to reveal jug, basin, etc., on a shelf, below which are shoe-rails and cupboard space. The top swings back and is fitted with a mirror.

A general-purpose room need not sacrifice appearance. Built-in furniture is a satisfactory compromise. A recess can house a fitted basin with a cupboard beneath and shelf and mirror above to serve as a dressing-table. The whole should be enclosed by a door, a folding wood screen, or a curtain. Clothes may be kept in a built-in cupboard, in preference to a wardrobe. If the room must contain crockery, cooking utensils, and even dry stores, they can be housed in a kitchen cabinet. *See also FURNITURE, ANTIQUE FURNITURE, COLOUR IN THE HOME.*

Furnishing Fabrics have never been more varied and interesting than they are to-day, for cheapness, durability, and good effect. Artificial silk fabrics in combination with wool or cotton—tapestries, damasks, etc.—are available in wide ranges. Most are suitable for any purpose, though for upholstery a material having long loose threads of silk on the surface is best avoided, as these tend to rub through on the arms of chairs, etc. Some of these fabrics are reversible, and are economical for curtains, as they do not require lining. Repps also are very popular, particularly multi-coloured varieties, as they harmonise with almost any colour scheme, and even if mainly of arti-

ficial silk wear well if carefully handled. Silk taffeta should generally be reserved for the formal type of drawing-room. Velvet is still popular, but it "shades" and marks too quickly for general purposes. For very large windows which it is necessary to curtain closely in winter, lined velvet can hardly be surpassed for warmth. Cretonnes and printed linens are inexpensive and durable, most being fadeless and washable. Floral designs are still popular, many having a background of geometric design in soft colours. Some new cretonnes have the design printed on both sides, while others have a perfectly plain reverse side, the former may be reversed when required and left unlined for curtains, and the latter if unlined would give a uniform look to the outside of a house even if various designs were used for interior effect. Printed linens are particularly durable, and are unsurpassed in quality, if block-printed by hand. Machine prints are also excellent and inexpensive.

Woven cottons, mainly in stripes and checks, are very suitable for the cottage style of furnishing, and are extremely durable. Cotton gingham at a few pence per yard can be recommended for bungalow or kitchen, and will wash and wear well.

For the nursery special inexpensive cretonnes are made with farmyard, fairy, and other suitable designs.

One of the latest upholstery fabrics is a mixture of wool and cotton with an over-check design, there are also many of the homespun or rural variety which accord particularly well with unpolished or weathered oak furniture.

Oil silk hangs well, and, like oil baize, is very suitable for bathroom curtains. Oil baize, or Lancaster cloth, is the modern and greatly improved variety of American cloth made in several thicknesses according to its backing. That on thin cambric or muslin is the most suitable for curtains, but a thicker type is employed for chair covers of the ultra-modern type. Plain colours are obtainable 45 in

wide and also a wide range of patterns in checks and floral designs

When making curtains of silk, cotton etc. a good width to allow is one and a half times that of the window. A heading of 1½-2 in. should be made at the top, stitched flat to a gathering tape. This tape is provided with a double string for pleating and pockets into which special hooks are fixed, thus bringing the work of rucking to a minimum. A 2-3 in. hem should be made at the bottom. Some require weighting at the corners either with lead buttons sold for the purpose or with a small bag of shot. The length of curtain to hang below the window sill is largely a matter of choice, but 3-7 in. is the most usual.

Upholstery loose covers can be made at home quite successfully with a little practice. By far the safest way for the amateur is to unpick an old cover and use this as a pattern. If no cover is available the cheapest material procurable should first be used and roughly made up as an experiment. Ready-made patterns are not generally satisfactory as the size and shape of various pieces differ so widely. A generous allowance should be made for tucking in round the seat and if a piping cord is used it should be stitched within a strip of material and afterwards secured between the two pieces of cover it is intended to join. Trill should be hemmed in position and then secured to the cover. The neatest method of tying on loose covers is generally by tapes from back to front and care should be taken that they do not show when tied.

Furniss Harry (1854-1903) British caricaturist was born in Wexford and came to London as a young man, his work appearing in leading illustrated periodicals. He was responsible for the legendary Gladstone collar and the traditional representations of Sir W. Harcourt, Sir Richard Temple and others. He illustrated the works of Dickens and Thackeray and was the author of *Confessions of a Caricaturist* (1901). *Harry Furniss at Home* (1903).

Poetry Bay (a novel) and *How to Draw in Pen and Ink* (1905). In his latter years he wrote and acted in plays for the cinema.

Furniture, articles of household use and adornment. Strictly speaking the meaning of the word is confined to movable articles (compare the French word *meuble*) fixed objects being fixtures or fittings, but with the introduction of built-in furniture the definition has to include pieces that cannot be moved. A modern built-in chest of drawers is as much a piece of furniture as a movable chest of drawers. A hanging cupboard fixed in a recess may be regarded as an immovable wardrobe. Some trade terms e.g. door furniture (see *Door*) emphasise the need for a comprehensive definition of the word.

Furniture has existed from the time



FIGURE 1. Sarcophagus with painted decorations c. 1400

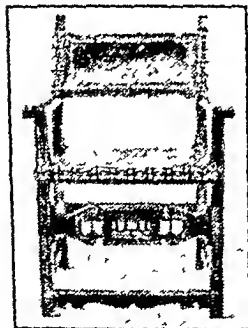
when a man first lived in a shelter and made for himself some form of bed and some kind of utensils. Where the articles have been made of an imperishable material such as stone, pottery or glass they have endured (e.g. the stone throne at Knossos). Very few objects made of wood have survived from even the Middle Ages, though a few pieces have been dug out of Egyptian tombs, notably the mortuary furniture of Tutankhamen. Under the Empire the Romans were great connoisseurs, lavishing extravagant sums on objects such as inlaid tables. In the Middle Ages the wants of a household were very few, being confined to beds, tables (generally on trestles), stools, benches, coffer-chests and cupboards. The scarce Master's chair was the seat of honour. The Crusaders brought back from the East

new ideas of domestic comfort and luxury, first expressed in more elaborate wall treatment and finer



Savonarola's Chair of Cordova. Leather back and seat and carved walnut. A typical example of Italian X-shaped chair

hangings. It was not, however, till the Renaissance that furniture began to be regarded as important Italy, as the cradle of the Renaissance turned her attention to the production of furniture designed to match the new creations of architecture and of sculpture. The early Italian cassone, or marriage-chest, carved in relief, decorated with gesso (plaster) work, and often painted and gilded, is characteristic of Italian Renaissance craftsmanship, which rightly regarded furniture as a branch of sculpture. Italian designers influenced all the other countries of Europe particularly France,



Spanish Chair 16th cent

Spain, and the Low Countries. The carved X-shaped Italian chair was everywhere copied. In the 17th century the baroque influence affected furniture as well as architecture and sculpture. This is especially seen in the so-called Louis styles of France. The reign of Louis XIII (1610-43) was a period of transition

The heavy Renaissance pieces, often in ebony inlaid with ivory, were gradually giving way to lighter and more graceful work. There began that struggle between classic formality and unbridled fantasy which lasted till the Revolution, and ended in the victory of classic formality. The long reign of Louis XIV (1643-1715) saw the gradual ascendancy of the rococo. Marquetry work reached its highest point of inge-



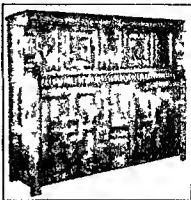
Louis XVI Small Ob'long Table, the top set with silver plaque, and the shelf with smaller plaque of tulip or kingwood

nity in the work of Andre Charles Boulle (q v, 1642-1732), who invented the fashion of covering furniture with an intricate inlay of brass and tortoiseshell. Brass arabesques for these pieces were designed by Jean Bérain (1638-1711). Other furniture of this period was richly carved, gilt, and covered with tapestry, possibly from the Gobelins factory, founded by Louis XIV in 1662. Tables had marble tops. Large pier glasses, their frames carved, decorated, and gilded, adorned the

walls. Wall panelling was over-elaborated in the flight from symmetry. Towards the end of this reign the importation of lacquered woods from China and Japan led French cabinet makers to produce a Western imitation. The most celebrated European workers in lacquer were the Martin brothers whose black lacquer or *Vernis Martin* was fashionable in the early years of Louis XV. Many of the finest pieces of this period were made for the palace at Versailles.

The first period (to 1723) of the reign of Louis XV (1715-74) known as the *Régence* continued and developed the art of Louis XIV. The genius of Jacques Caffieri (1678-1750) the famous *ciseleur* (metal-chaser) re-deemed the earlier Louis XV style (*rocaille*) from its affected conventionalism. Great designers and *ébénistes* (cabinet makers) of this period were J. A. Meissonnier (1691-1760), J. F. Oeben (d. 1767) and J. H. Riesener (1734-1800). The marquetry of the Louis XV period as exemplified on the commodes displays consummate

sally gilded and covered in tapestry. The *canapé* or sofa to seat three th-

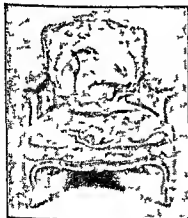


Tudor to 16th century

causse (for two) and the *haise longue* (for one) are innovations to gether with the *bonheur du jour* or small boudoir cabinet. There appears to have been an almost universal horror of the straight line. Commodes were serpentine shaped, chairs and tables had cabriole legs and their seats, backs and arms were all curved. The inevitable reaction to straight-lined classicism occurred in the reign of Louis XVI (1714-93). Great cabinet makers such as Riesener, who had been familiar with the old, helped to inaugurate the new style. The ornament is a little more restrained though the Sèvres plaques which were introduced before the end of the previous reign strike a somewhat discordant note.

The Empire style of Napoleon, with its uninspired adoption of classical details, notably the outward-curving foot and the scroll, comes rather as an anticlimax.

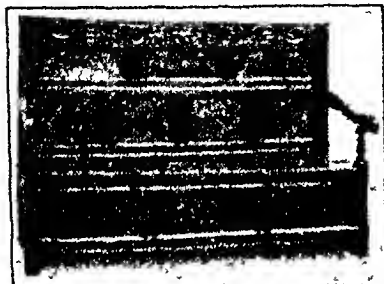
In England, medieval furniture was largely made of oak but the so-called *Age of Oak* is usually confined to the period of the Tudors (1485-1603) and Stuarts (1603-88). Very little early Tudor furniture is preserved.



Louis XV style chair with Gobelins tapestry

craftsmanship and exquisite taste. Chairs and settees were almost univer-

The small oak hutches or store cupboards are characteristic. Chairs, still scarce, are decorated with bold car-



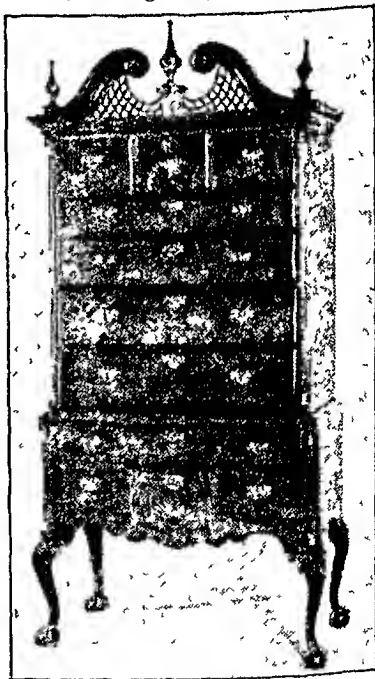
James I Oak Settle with panels inlaid with bog oak and holly

vings, but the benches and stools remain plain. The monk's bench, or settle, had a back which could be converted into a table-top. Tudor tables and the so-called refectory tables had four carved bulbous legs joined by stretchers, or a central support with splayed legs. Still more massive is the four-poster bed, with its bulbous supports and heavy cornice. The livery cupboard, the dole cupboard, and the armoire (ancestor of the modern wardrobe) are characteristic. Especially pleasing was the linenfold panelling, usually seen on walls, occasionally on furniture.

The reign of Elizabeth (1558-1603) saw the introduction of court cupboards, or cupboards with a recessed upper section, extensively carved, and a heavy cornice, supported by a prop at each end. These props varied greatly in design, some of them being merely turned pillars, others swelling out into protuberances akin to those on the table-legs and bed-posts. Later ones (mainly of the Stuart period) were human figures (Atlantes or Caryatids). Occasionally, instead of props, the cornices had acorn-shaped ornaments which did not reach to the shelf below. Renaissance influence is seen in the arches, which were sometimes carved on the façade and cornice. Later court cupboards were often

dated. They appear to have been much commoner in the N of England than in the S. The name is said to be derived from the French *court*, short, to distinguish these cupboards from the larger *dressoirs*. Another Renaissance feature is inlays, which were used with good effect both on wall panelling and on furniture panels.

With the accession of the Stuarts came many innovations, among them the gate-legged table (sometimes attributed to the Cromwellian régime), with turned or spiral legs, and a less cumbersome chair, with small rectangular back and square seat, covered in leather, and legs very similar to those

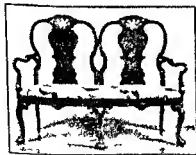


American Cherry wood Highboy, c 1770

of the gate-legged table. The heavy carved oak chair was not, however, superseded. The draw-leaf table, so

popular with designers of modern mass produced furniture was earlier. The chest of drawers the most useful piece of furniture ever invented was being evolved from the oak chest or coffer. At first one or two drawers were placed at the bottom of the chest towards the time of the Restoration complete chests of drawers were being made. At first these chests of drawers were placed on stands which developed into the highboys tallboys and double chests so popular in the 18th cent. the bracket foot now a commonplace appears to have been introduced c 1680. A tapestry factory was established by James I at Mortlake but it declined during the Commonwealth.

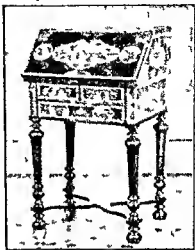
The Restoration introduced many changes and innovations. The severe and plain Cromwellian furniture was supplemented by pieces designed in the French taste and the craftsmen of Louis XIV were beginning to influence English designers though neither Boulle work nor marquetry was ever popular in England. Chairs were becoming more comfortable. Upholstered seats known to James I but banished by Cromwell became common. A new type of chair with high cane filled back and cane seat came in perhaps from Holland. The carving



Queen Anne Walnut Settee

of the period was influenced by the work of Grinling Gibbons (1648-1721) although that famous practitioner may

not actually have carved any furniture. Walnut chairs with high carved backs and upholstered seats were intro-



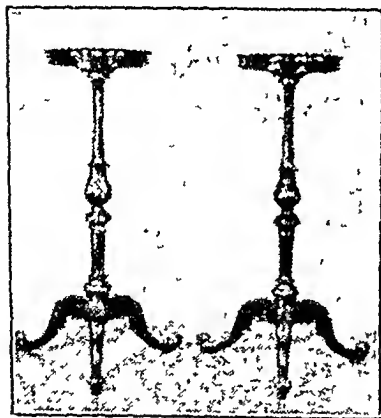
William and Mary Walnut Bed

duced. Day beds anticipated the *chaise longue* of Louis XV. The importation of works of art from China and Japan produced an enthusiasm for lacquer or japauning comparable to that which the Martin brothers were to foster in France. Charles II lacquer cabinets on elaborately carved or modelled gilt stands are excellent examples of this fashion.

The glass factory opened by the 2nd Duke of Buckingham at Vauxhall (whence Vauxhall plate) encouraged the manufacture of mirrors with carved inlaid or lacquered frames. A rudimentary form of bureau foreshadowed the exquisite examples of the Queen Anne period. Stuart furniture was made especially attractive by the introduction of brass handles, knobs and escutcheons a fashion continued until the 19th cent. each period having its own designs. This brasswork suited the English genius far better than the heavy brass and ormolu fittings of the French craftsmen. By the

reign of Victoria much of this brass-work was doubtless lost, and Victorian carpenters stripped off the rest, replacing it with those massive wooden knobs, that appealed to them so much.

The accession of William and Mary produced a striking change in furniture. The *Age of Walnut* began Dutch influence at first was paramount—high-backed chairs, anticipating the Queen Anne style, relied more on form than on carving. The sinuous stretcher was used on stands for chests of drawers and bureaux. The surfaces of cabinets, drawers, etc., were ven-



Pair of Chippendale Torchères

eer, and inlaid. Some of the work was spoilt by excessive marquetry, and the more extravagant Dutch shapes (particularly the *bombe*) were heavy and uninspired.

It remained for the Queen Anne period (till c 1730) to refine the Dutch heaviness of William and Mary. Walnut was still supreme, though towards the end of the period mahogany was seen in a few small pieces, such as wall and toilet mirrors. The cabriole leg, with carved knee and claw-and-ball or "hoof" foot, was characteristic of the chairs. Small dining-chairs had solid splats and rounded uprights. Low and winged

easy chairs made their appearance. Stuffed-back settees, often covered with petit-point needlework, added to the comfort of a room. The greater neatness and skill was expended on bureaux, tallboys, and cabinets. The upper parts were often fitted with Vauxhall plate mirrors. Remote from the ponderous products of William and Mary, the Queen's craftsmen produced in this century many of those exquisite small pieces which are the envy of present-day collectors. Gilded gesso-work in wall mirrors and in small tables.

The activity of architects in the early Georgian period coincided with the popularisation of mahogany. The first pieces of the *Age of Mahogany* were often actually designed by architects, and had an architectural flavour. The influence of the baroque in architecture influenced the new style, and classical architraves, cornices, and pediments appeared on bookcases, cabinets, and other large pieces. The shepherd's head, the satyr-mask, and the lion-mask were introduced; the baroque was betrayed; while the gesso, and marble were copied from France. The most noteworthy example of an "architectural" furniture designer was William Kent (1685-1748), who was responsible for the exterior and interior of Sir Robert Walpole's mansion, Houghton Hall, Norfolk. His more famous successor, Robert Adam (see below), covered the same field.

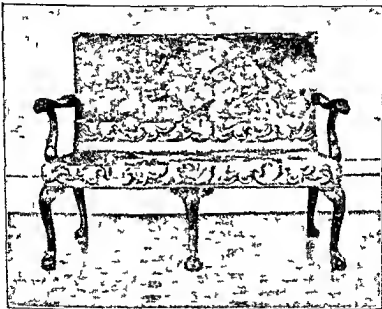
The furniture of the period included gilt console tables (copied from the French), and mahogany side-tables, card-tables, and other pieces. Chests of drawers had straight fronts and serpentine fronts. Bureaux continued to be made. China cabinets were introduced.

Thomas Chippendale (q.v.; c 1729), the best-known of the 18th-century craftsmen, did not disdain to borrow from many sources, but in so doing created a new style of his own. He was equally happy with any material of furniture, he is most famous for his chairs and settees. The solid splat

the Queen Anne and Early Georgian periods was replaced by a pierced splat the more advanced examples of which such as the ribbon back show great beauty of design and carving Chippendale passed through many phases in his career The earlier French influence gave way c 1750 to a Chinese fashion when he attempted with more ingenuity than taste to give a Chinese look to h

from these experiments which are now at worst antiquarian curiosities there is no doubt that the school of Chippendale (he could not have himself produced one tenth of the pieces attributed to him) gave to English cabinet making a prestige not inferior to that of France

About the same time Robert Adam (1738-1796) as ADAM STYLE) was adapting classical details to the require

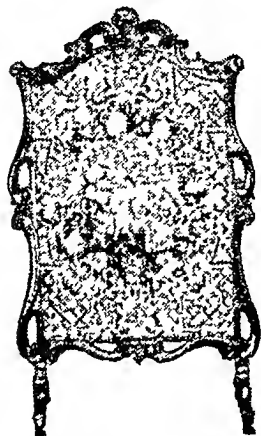


Chippendale mahogany settee with pierced work.

tables and chairs and to construct cabinets looking like pagodas Much happier was the fretted furniture of his middle period Chippendale also experimented with French styles as was to be expected from the reputation of the contemporary cabinet makers of Louis XV His least successful work was in his so-called Gothic style the motif of the pointed arch being out of harmony with the prevailing style But apart

ments of furniture without committing the faults which had marred the work of the earlier architectural designers Another contemporary George Hepplewhite (d 1786) kept more closely than Robert Adam to the general style of Chippendale But Hepplewhite evolved a style of his own He is responsible for the shield back chair Chair-legs were made tapering with or without spade feet or else straight and reeded In his more

elaborate examples the cabriole leg, with husk-and-honeysuckle carving



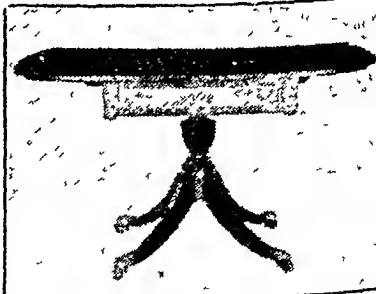
Regency Cheval or Horse screen, in walnut, pieced and carved, with needlework panel

and ball-and-leaf foot, is to be found. Some of his "French" chairs (for Hepplewhite too admitted French influence) have the slight cabriole leg of the Louis XV style. The "French" chairs, with their stuffed backs and curves, can sometimes only be distinguished from real French pieces by their freedom from gilding. The ladder-back chair, though not exclusive to Hepplewhite, is a favourite type. The sideboard, already known as a sideboard-table, is developed into a more convenient piece of furniture, with roomy cupboards and drawers.

Somewhat later in the century came the third great English cabinet-maker, Thomas Sheraton (*qv*, 1751-1806). Sheraton was 28 when Chippendale died and 37 when Hepplewhite died; he must therefore have felt their influence, if only to object to it. His furniture is characterised by strength and grace; it is light, without being flimsy. Mahogany was still the most popular wood, though satinwood occasionally appeared. Inlay was much more freely used, some of Sheraton's table-tops and trays having almost the appearance of marquetry. His chairs, which were generally smaller than those of Chippendale or Hepplewhite, had a bottom rail at the back; the chair legs were straight, tapered, or (in his latest examples) turned. Generally speaking, Sheraton followed the straight lines of Louis XVI. Some of his furniture was painted and decorated, the satinwood pieces especially lending themselves to this treatment. Towards the end of his life Sheraton became infected with the *Empire* virus, and produced objects which definitely belong to the "decadence".

After Sheraton's death English furniture-making declined, though in the country old-fashioned craftsmen were still making pieces after the 18th-century models for another 50 years. Regency furniture was but an English copy of French Empire. The Victorian age aimed at comfort and let beauty take care of itself, though in one respect—papier-mâché (*qv*)—it did produce some charming pieces of furniture. In the eighties of the 19th century William Morris (*qv*; 1834-1896) led a movement for more beauty in house-furnishing, and, though he singled out mediæval objects for admiration, he awakened an interest in antique furniture generally. This led to the rescue of many beautiful pieces that had been consigned by the Victorians to their attics and kitchens. Period furniture became fashionable and the faker began to operate.

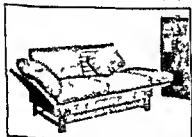
At the beginning of the 20th century appeared the short-lived *New Art*



Carved Mahogany table by Phyllis, New York c 1810

craze, which insisted on fumed oak, oxidised hearts, and pictures framed asymmetrically. Since the World War

many interior decorators have attempted to evolve a modern style its chief characteristics are simplicity of form absence of decorations and general lightness of appearance Steel framed furniture is still too expensive to be very popular It has the advantage that it is in line with the modern desire for ease in cleaning but its form has not so far attained the quiet dignity of some of the older furniture and there is too much evidence of self-consciousness and inconsistency A particularly noticeable example of inconsistency is the case of the fast-dying fashion for limed oak This is modern machine made oak furniture designed on modern lines but treated to look



Modern Settee Bed

old or weathered On the other hand some attractive and ingenious examples of veneering with exotic woods are to be found the quarters almost attaining the beauty of Queen Anne veneered furniture

The fault of modern furniture is that most of it is machine-made It is only reasonable to say that when the craftsman yields to the machine the products of craftsmanship must disappear The time will doubtless come when hand made pieces will be found only in museums and the houses of the rich and the majority of people will have forgotten (if they ever knew) how to recognise furniture of merit

See Illustrations Vol 4 facing pp 168 169 184

Furniture, Antique *see* ANTIQUE FURNITURE

Furse Charles Wellington (1868-1904) English painter Exhibited first at the Royal Academy in 1888 and later became a member of the New English Art Club In 1904 he was elected A R A His vigorous open air paintings won considerable popularity and among his best known works are *Diana of the Uplands* *Lord Roberts* and his decorations in the Liverpool Town Hall

Furse Dame Katharine (b 1875) founder and Commandant in Chief of the V A D daughter of John Addington Symonds She married C W Furse the painter in 1900 On the outbreak of the World War she went to France to organise Voluntary Aid Detachments returned to England in 1915 and became Commandant in Chief of the V A D's attached to the Red Cross Society In 1917 she was created a C B E and became Director of the Women's Royal Naval Service resigning her V A D appointment She held the naval appointment for years when she became Director of the World Bureau of Girl Guides and Girl Scouts

Furtwängler Wilhelm (b 1886) German conductor popular in Great Britain for his visits with the Berlin Philharmonic Orchestra He became conductor in 1920 of the Gewandhaus Concerts at Leipzig and the Berlin Philharmonic Orchestra in succession to Nikisch He has made his orchestra into a perfect instrument which however he has been charged by critics with putting to unduly theatrical uses He left Germany in 1933 as a result of the Anti Jewish movement

Fuse *see* CORDS

Fuse (1) In electrical engineering a short wire introduced as a protective device into a circuit to prevent overload The wire is of such a gauge that it melts and breaks the circuit when the current exceeds a certain value If the fuse were short an arc might form across the gap hence a long wire

is looped round a porcelain plate which keeps the circuit open, or is buried in sand or other powder. (2) A device for igniting a charge of explosive at a desired instant. In blasting (*q v*) an electrical fuse similar to that described above is buried in a charge of detonating powder, ignited by a current sent through the thin wire and heating it to melting-point. In earlier times the charge was ignited by a *cord fuse*, a tube of fabric having a core of black powder which burnt rapidly but not instantaneously when lighted at one end. The other end was buried in the blasting charge. Fuses used to ignite the charges of shells fired from guns, or thrown from aeroplanes, are either *percussion* or *time*. The percussion fuse ignites the charge of explosive in the shell through the shock of striking an object, by a detonator similar to that used for igniting the charge in the gun. Time fuses are used chiefly on shrapnel and anti-aircraft shell, and depend upon the rate of burning of a train of powder, as in the cord fuse, but the fuse is so constructed that it is ignited as the projectile leaves the gun, and a variable means for setting to the time is provided. Fuses are also made with clockwork timing. These devices cause the shell to burst in the air at a predetermined point without impact.

Fuselage, see **AEROPLANE**

Fusel Oil, the residue left after removing the ethyl alcohol from various liquors obtained by fermentation, potato spirit being the best source. Fusel oil consists principally of iso-amyl and normal amyl alcohols, together with smaller amounts of butyl alcohol, and various aldehydes and esters. It is a poisonous, unpleasant-smelling, oily liquid which distils mainly between 120–130° C. Its principal use is as a source of amyl alcohols (*q v*).

Fusible Alloys, a series of alloys with a very low melting-point, usually below 100° C. These metals are used

as plugs in various sprinkler devices, they melt with a slight rise in temperature, thereby releasing the water. They are also employed in solders. These latter have, however, a considerably higher melting-point. All fusible metals contain a certain proportion (usually c. 50 per cent.) of bismuth, the other constituents include lead, tin, cadmium, and occasionally mercury. The following are the principal fusible alloys

Rose's metal	Bi 50 Pb 25 Sn 25 per cent ; M.P. 94° C.
Wood's metal	Bi 50, Pb 25, Sn 12.5, Cd 12.5 per cent, M.P. 71° C.
Lipowitz's alloy	Bi 60 Pb 26.5, Sn 13.5, Cd 10.2 per cent, M.P. 63° C.
Anatomical alloy	Bi 53.5, Sn 19, Pb 17, Hg 10.5 per cent, M.P. 60° C.

Fustel de Coulanges, Numa Denu (1830–1889), French historian, is the author of many historical works, including *La Cité Antique* (1864), which was translated into English in 1874.

Fustian, term applied to a large number of fabrics of heavily weighted cotton cord, and to pile fabrics. Corduroy is sometimes called fustian.

Futures, dealings in goods not yet "ascertained" or produced. Futures are usually bought by manufacturing houses to ensure themselves a constant supply of raw material at a fixed price, in order to be relieved of the speculative business of watching the market. The fixing of future prices is a highly complicated process undertaken on the various commodity exchanges, where calculations are made on the basis of crop and weather reports and many other factors. If a shortage is likely, futures will be dearer than "spot" prices, if a glut, they will be cheaper. The most important English market in futures is that in cotton, carried on at the Liverpool Cotton Exchange, where contracts even a year ahead may be concluded. In the USA there are important future markets in wheat and coffee.

Futurism, see **PAINTING**.

gabardine

Gabardine, fabric particularly suited to water proofing composed of fine rotary wool yarn warp and cotton weft. All wool gabardines are now also woven.

Gabbros, basic rocks solidified under great pressure at considerable depths in the earth's crust. They are coarse grained and consist of plagioclase feldspar (qz) with augite. Sometimes the term is widely used to include similar rocks composed of the same feldspar with other minerals and according to the minerals contained they are known as norites, troctolites, enclinites etc. The feldspar crystals may be enclosed in the others. Gabbros are typically dark-coloured and the constituent minerals distinguish them from diorites. They are widely distributed. The Carrock Fell gabbro in Cumberland is well known. They also occur at the Lizard, St Davids, Aberdeen, the NW Highlands and especially Skye and in Scandinavia, Saxony, the Alps, E. Canada and the Rocky Mountains. They may contain iron ore of poor quality and are sometimes used for road metal and building purposes.

Gabelle, a tax on salt imposed in France from 1286 to 1790. It was most unequally levied and was the cause of much discontent.

Gaboon, *see* FRENCH EQUATORIAL AFRICA.

Gaboriau, Emile (1835-1873) French novelist and creator of M. Lecog, the French Sherlock Holmes. His detective stories include *L'affaire Leroy* (1866), *Le Crime d'Orcival* (1868), *Ma sœur Lecog* (1869) and *L'Argent des Autres* (1871).

Gabriel, St., the Archangel who announced to Mary the forthcoming birth of Christ. He is revered by Jews and Moslems as well as Christians and is commemorated on March 24.

G

Gade

Gaddi, surname of a great Florentine family.

Gaddo Gaddi was a painter and mosaic artist who lived (c. 1260-1333). He is supposed to have been a friend of Cimabue and Giotto. Vasari states that he executed the mosaics in the portico of S. Maria Maggiore at Rome and also those of the *Coronation of the Virgin* in the Duomo at Florence.

TADDEO GADDI (c. 1300-1366) Gaddo's son is said to have been a pupil of Giotto. His chief work is in the Church of Santa Croce at Florence where he painted a series of frescoes including a *Last Supper*. He also painted the altarpiece of the *Madonna* in the Berlin Museum and that in the Uffizi. Other works have been attributed to him though with less certainty. His merits remain somewhat overshadowed by those of Giotto but his work has individuality and considerable force.

ANGELO DI TADDEO (c. 1333-1396) was the son of Taddeo. Frescoes by him in Santa Croce at Florence illustrate the *Legend of the Cross* and a *Coronation of the Virgin* in the National Gallery formerly catalogued as School of Giotto is now attributed to him. His work is inferior to that of his father.

GIOVANNI GADDI (d. 1383) Agnolo's brother was also a promising painter. Another brother ZANOTTI GADDI became Florentine Ambassador to Venice where his descendants were prominent citizens and art collectors.

Gade, Niels Wilhelm (1817-1890) Danish composer, a pioneer of the Danish school of music. He began his career as a violinist in the Royal orchestra. In 1841 his overture *Echoes of Ossian* brought him to the notice of the King who sent him to study at Leipzig. There he met Mendelssohn.

whom he succeeded as conductor of the Gewandhaus concerts. In 1848 he returned to Copenhagen, becoming joint founder with J P Hartmann of the musical conservatorium. His main work consisted of orchestral symphonies, but he also wrote cantatas—*The Erl-King's Daughter*, *Psyche*, *Spring Message*, and *Spring Fantasy*—and pieces for the violin and piano. He became Director of the Court Orchestra and of the Musical Union.

Gadfly, another name for the bot-fly, sometimes also applied to the horse-fly (*qq v*)

Gadolomite (or *ytterbite*), a naturally occurring (principally in Scandinavia) complex silicate containing beryllium, iron, and many of the rare earth metals, of which latter it is an important source. The principal rare earths that occur in it are yttrium and erbium, together with smaller amounts of cerium and lanthanum.

Gadolinium. For the characteristics of gadolinium see article ELEMENTS. It is a metal belonging to the group of rare earths (*q v*). It is to be found in the mineral gadolinite (*q v*) and in others. It is somewhat more easy to separate than other rare earth elements, owing to the lesser solubility of its nitrate.

Gadwall, a wild duck found over the greater part of the N hemisphere, and both a resident and a winter visitor to Great Britain. It is about the size of the ordinary wild duck, but the drake is not so gaudily coloured. Both sexes have a white patch on the wing.

Gaede Pump, see AIR PUMPS

Gaekwar [GĪK'WAR], name of the Mahratta family which governs Baroda, a feudatory State in India. The present Maharajah, Sir Sayaji Rao III (b 1863), was invested by the British in 1881, and is one of the most progressive rulers in India.

Gaelic Language and Literature, see CELTIC LANGUAGE AND LITERATURE

Gæta, an important port of ancient and modern times, in Campania, Italy, c 70 m N of Naples. It has sustained many sieges. Pope Pius IX took refuge here, 1848–1850. It was

besieged by the Sardinian army in 1861. Pop 19,300.

Gage, Thomas (1721–1787), British general. He joined the British forces in America in 1754, and was given chief command. As Governor of Massachusetts (1774) he carried out the Boston Port Act, the colonists' opposition to this measure resulting in the outbreak of the War of Independence. He was recalled after the battle of Bunker Hill.

Gainsborough, market town and river-port, Lincolnshire, on the Trent, 16 m NW of Lincoln. There are engineering works, oil-cake factories, and foundries making agricultural and harvesting machinery. It was the scene of the marriage of Alfred the Great and Elswitha in 868. Pop (1931) 18,684.

Gainsborough, Thomas (1727–1788), English portrait and landscape painter, born in Sudbury, Suffolk. As a child he spent all his leisure and much of his school-time in sketching, and at the age of 14 was sent to study in London. In 1747, on marrying a young lady of some means, he settled in Ipswich, where he painted landscapes and portraits for 12 years. He then took his family to Bath, where he speedily attained considerable standing as a portrait painter among local fashionable society. He painted portraits of Sterne, Richardson, and Garrick, and continued with the landscape work which he always preferred. In 1774 he was able to move to London, where he had rooms in Schomberg House, Pall Mall. His success was maintained in London, and he painted a series of portraits, including Sheridan, Clive, and Mrs Siddons. He was a foundation member of the Royal Academy, but resigned in 1784, indignant at the way in which one of his portraits was hung. Fourteen years after coming to London, he died of cancer.

During his lifetime Gainsborough was rivalled only by Reynolds, opinion as to which was pre-eminent has fluctuated considerably since, though on the Continent Gainsborough is

Bone chicken or fowl Lay skin side downwards on board Cover with half sausage meat Cut ham, tongue, and bacon into oblong pieces, and place at intervals with mushrooms, truffles, and egg, seasoning well Roll up, and sew edges together neatly Tie in scalded cloth Place in boiling water or stock, and simmer (allow 40 minutes to the lb) Press between two boards, with heavy weight on top Trim ends, and brush with melted glaze

Beef Galantine

- 1 lb best steak
- 2 oz ham
- $\frac{1}{2}$ lb sausage meat
- 1 or 2 eggs to bind
- 4 oz breadcrumbs
- 1 teaspoonful chopped parsley
- Pinch of herbs
- Allspice
- Stock (c 1 gill)

Mince steak and ham Mix with sausage meat, eggs, breadcrumbs, parsley, flavouring, and seasoning Add sufficient stock to make of a moist consistency Make into a roll Tie in a greased pudding-cloth Simmer 2-2 $\frac{1}{2}$ hours Remove cloth, tie in greased dry cloth, and place between two plates with weights on top When cold, brush with glaze Cut thin slice from each end

Galapagos Islands, a volcanic group in the Pacific, belonging to Ecuador, covering an area of 2868 sq m Sulphur is found here, but little else On Charles Island there is a penal settlement These islands, often called the tortoise Islands, were discovered by a whaling ship towards the end of the 18th cent. Pop (1931) 2000

Galatea [GALŌTĒ'Ō], in Greek mythology one of the Nereids (water-nymphs); was beloved by the Cyclops Polyphemus, but spurned him and gave herself to Acis, a shepherd The Cyclops cast a rock at them, and Acis was killed, but Galatea turned his blood into a stream which still flows from beneath the boulder The legend is a favourite subject for artists. The

name Galatea was also given to the statue of Pygmalion which came to life.

Galatia, an ancient kingdom in Asia Minor, founded by the Gauls after their defeat at Delphi, 279 B C Their peregrinations in Asia Minor were thwarted by Attalus I, King of Pergamum (241-197 B C) Mark Antony conferred the kingdom on Amyntas, and it was made a Roman province by Augustus (25 B C) It is said that St Paul twice visited Galatia in A D 51 or 53, and in A D 56 (see Acts xviii 23)

Galatians, Epistle to, book in the New Testament written by St Paul with the object of counteracting a Judaising tendency amongst the Galatians, including probably the Churches of Antioch and Iconium

Galatz, a port on the Danube, Moldavia, Rumania, situated near the Black Sea It is an important grain centre and the headquarters of the Danube Commission There are soap and candle factories and petroleum refineries There is a British Consulate General Pop (1930) 101,150

Galaxy, see COSMOLOGY

Galba, **Servius Sulpicius** (5 B C-A D 69), a wealthy noble, served as consul in Gaul, Germany, Africa, and Spain and was made Governor of Hispania Tarraconensis by Nero On Nero's death (68) the Praetorian Guard declared him emperor, but he lost popularity through his avarice He was deposed by Otho, and slain by the latter's soldiers

Galdós, **Benito Perez** (1845-1920) Spanish novelist and dramatist, born in the Canary Islands He studied law, but forsook it for literature His first work was *La Fontana de Oro* (1870), followed in 1876 by *Doña Perfecta* (a novel) In 1873-9 he published his series of 50 volumes entitled *Episodios Nacionales*, which depicted the history of Spain during the 19th cent in fiction form In 1881 *Gloria* appeared, and other novels followed including *Trafalgar* (1873), *Marianela* (1878), and *Nazarin* (1895) possibly his greatest work. *Electra*

(1901) is his best known drama. He sat in the Cortes as a deputy in 1885.

Galen (c. A.D. 131-200) Greek physician born at Pergamum. At the age of 34 he went to Rome where he became a friend of Marcus Aurelius who secured for him the post of physician to Commodus. Galen had not the direct simplicity of Hippocrates (q.v.) and although his scientific work is marred by superstition his system of medicine is remarkably complete and was consulted for 1300 years. He also wrote on philosophy, logic and ethics praising the self-denial of the Christians.

Galena (*Lead Sulphide*) the most important lead ore, nearly all the metal of commerce being derived from this source. It is lead grey in colour, heavy, with a bright metallic lustre and may at once be distinguished by the cubic shape of the crystals which are often several inches across. Sometimes other forms of crystals are met with, and it also occurs massive. It is found in beds or veins in igneous and metamorphic rocks or as a secondary deposit in cavities in limestones, often associated with silver. In Britain it occurs in Cumberland, Cornwall, Derbyshire, the Isle of Man and elsewhere. Other localities are Saxony, Sweden and Colorado.

Galicia (1) The most S. part of Poland comprising the N. slopes of the Carpathians. Formerly a crown land of the Austro-Hungarian Empire this area was annexed to Poland after the World War. It contains the towns of Cracow, Lemberg (Lwow) and Przemyśl which figured in the campaigns of the World War. Area 31,300 sq. m. pop. 8,500,000. (2) An ancient kingdom and province of N.W. Spain, now divided into the provinces of Corunna, Lugo, Orense and Pontevedra. The dialect of Spanish spoken there differs considerably from Castilian and has many affinities with Portuguese. The largest town is Corunna and the ancient capital was Santiago de Compostella. Area 11,260 sq. m. pop. 2,433,000.

Galilee Roman province of N. Palestine, cradle of Christianity. The disciples of Jesus were first called Galileans. Its N. boundary abutted on the S. Syrian border and its E. was the Sea of Galilee which now separates it from Transjordan. Its principal cities are Tiberias and Safed. It is now the scene of extensive Jewish resettlement and numerous new Jewish agricultural colonies. During the past few years the construction of good motor roads has made Galilee more readily accessible to tourists. Near Tiberias there are valuable medicinal springs used by the Hebrews and Romans in ancient times.

Galileo

Galileo

(1564-1642)

Italian

scientist was

born at Pisa

In 1581 he

went to the

University of

that city

to study

medicine

but soon be-

gan to take

an interest

in mathe-

matics and

became lecturer

in that subject

at his University

He demonstrated

experiment that

bodies fall with

equal velocity

irrespective of

weight. He also

showed that the

path of a

projectile is a

parabola. Owing

to the influence

of his opponents

he was forced

to resign and

from 1592 to

1610 was

Professor of

Mathematics

at Padua.



Galileo Galilei

During this time Galileo made considerable improvements in the telescope, observed the mountain ranges on the moon and the Milky Way which he discovered was composed of a multitude of stars. The Church, however, feeling that his claim to have proved his doctrines was premature and might endanger the faith of the less well-instructed, attempted to

suppress him, and for 16 years fear of punishment kept him silent. But the publication of his *Dialogue on the Ptolemaic and Copernican Systems* led to his arrest and imprisonment by the Inquisition. He was compelled, under fear of torture, to sign a recantation of his assertion that the earth moves. It is said that, rising from his knees, he then exclaimed, "Eppur si muove" (For all that, it does move), but this historic remark is alleged to be unauthentic. He made further important astronomical observations after his release.

Gallatin, Albert (1761-1849), American politician, b in Switzerland. He entered Congress in 1795, became Secretary of the Treasury under Jefferson (1801), and introduced many financial reforms. He resigned to negotiate with England after the war of 1812-14, and was later Minister to France, and to England (1826-7). He founded the American Ethnological Society.

Gall-Bladder, a muscular organ lying in the upper part of the abdomen beneath the liver. It serves as a reservoir in which bile from the liver collects and concentrates, and when food, especially fatty food, enters the duodenum, the gall-bladder empties through the bile duct. It is often the seat of disease, especially in women who are fat and have borne a large family, such people are peculiarly liable to develop *gallstones*, one type formed of cholesterol being more or less harmless and formed in normal bile, and another composed of calcium carbonate, produced in infected bile, being very painful and necessitating removal by operation in almost all cases.

Galle (or *Point de Galle*), port on S.W. coast of Ceylon. Its exports are tea and coconut oil. Pop (1931) 38,424.

Galleon. A large warship, heavily armed, with 3 or 4 decks, used by the Spaniards in the 16th cent. The name was afterwards applied to Spanish merchantmen, and especially to the treasure-ships which carried gold and silver from America.

Galley. A long, narrow boat propelled by large numbers of oars, sometimes supplemented by sails. Used by the Greeks and Romans for war, and by the Mediterranean sea-powers in the Middle Ages. Normally galleys had c 50 oars, each manned by 6 or more men, who in the classical period were slaves and in mediæval times condemned criminals and prisoners of war. They were last used extensively at the battle of Lepanto (1571). The name is also given to a tray used by printers to hold type which has been set.

Gallic Acid (3-4-5, *Trihydroxybenzoic Acid*), a colourless crystalline compound of formula $C_6H_3(OH)_3COOH$, which melts with decomposition at c 230° C. It occurs in nature in various plants, such as tea, nut-galls, and pomegranate roots. It is usually manufactured by the action of mineral acids on tannin. On exposure to air it rapidly absorbs oxygen, with a consequent darkening in colour. It is used in photography and in the manufacture of pyrogallol (qv). Some of its salts are used in medicine: *dermatol*, which is employed as a skin antiseptic, being bismuth gallate, and *airol*, which is used for similar purposes, being bismuth hydroxyiodide gallate.

Gallicanism, a theory that both Church and State in France had certain rights of their own, independent of the authority of the Pope. It was opposed by *Ultramontanism*, which upheld the centralisation of affairs at Rome, and the Vatican regarded its followers as heretics. Gallicanism held that the bishops had equal authority with the Pope and that kings, being granted their power by God, were outside the Pope's jurisdiction. The theory became important in the Reformation period, and its principles were embodied in a Declaration of the French Clergy by Bossuet in 1682, which however, after a quarrel with Rome was withdrawn. Napoleon I embodied the Declaration in a statute. The ancient "Gallican Liberties" exercised an influence until 1905.

Gallican Liturgy *see* LITURGY

Galli Curci Amelita (b 1889) famous coloratura soprano born in Milan made her debut in *Rigoletto* in 1910 at Rome. After successes in Madrid and Buenos Aires she sang to her first English speaking audience at Chicago in 1916 with remarkable success. She soon became enormously popular throughout the United States where she sang habitually to huge audiences and created another large public for herself in this country by means of her gramophone records which aroused such interest that the Albert Hall was sold out 9 months before her first concert here in 1924. She toured the British Isles in that year and again 6 years later. Her voice is a remarkably agile and even instrument of great appeal by reason of its smoothness and flexibility though lacking the colour and warmth of Tetrazzini's or the purity of Melba's. She has now virtually abandoned the operatic stage for the concert platform.

Gallieni, Joseph Simon (1849-1916) French general and statesman. He was administrator in the Upper Niger and Upper Senegal and in 1896 subdued Madagascar. Was made military governor of Paris in 1914 carrying out Joffre's orders for the counterstroke which developed into the first battle of the Marne (qv). Gallieni joined Briand's cabinet as War Minister in 1915.

Gallinae, general name for all the birds of the fowl tribe including pheasants, turkeys, peacocks, partridges, quail, grouse and the like.

Gall insects belong to the two orders Diptera and Hymenoptera and are respectively called gall midges and gall wasps. Gall midges are minute gnat-like flies which may cause considerable damage to plants (*see* HIRSIAN FLY). They attack all parts of the plant: the bud, leaf, fruit, stem or root, and are particularly partial to grasses, composites and willows, the larvae producing various deformities in the affected parts. The gall wasps similarly deposit their eggs in plant tissue

the galls their larvae produce being much more conspicuous and remarkable than those of the gall midges. The oak is especially attacked, three familiar galls on this tree being the marble-like oak apple, the sponge gall made on the foliage and a scaly gall like a fir cone on the young shoots. Another common gall is the mossy pink-coloured growth found on rose trees. Some beetles and flies are also gall makers.

Gallipoli (Turk *elibol i*) seaport in European Turkey in the vilayet of Adrianople at the northern end of the Dardanelles. During the World War the town suffered severely. There are mosques and Roman and Byzantine remains including traces of a supply depot built by Justinian I, op. estimated 30,000.

The isthmus at Bulair some eight miles N of the town where the Gallipoli peninsula sinks to under 500 ft and narrows to less than 4 m. was fortified in 1854 by the allied British and French armies who occupied it. The fortifications were strengthened in view of the Russian advance on Constantinople in 1878 and are still standing. During the World War (qv) the guns at Gallipoli commanded the entrance to the Sea of Marmora (*see* DARDANELLES CAMPAIGN).

Gallium. For the characteristics of gallium *see* article ELEMENTS. A somewhat uncommon metal found in small amounts in zinc blende and also to a slight extent in aluminium and iron ores.

Gallium melts at c. 30°C and is therefore often considered along with mercury and bromine as a liquid element especially as it remains supercooled to several degrees below its freezing point. This low melting point together with its high boiling point (over 1700°C) would make it a suitable thermometric medium were it more easily available.

Chemically gallium is similar to aluminium with which it forms an alloy.

Galloway district of S.W. Scotland

composed of Wigtownshire and Kirkcudbright, famed for its ponies and hornless cattle. During the 12th cent this area was called by the English the land of the Picts. The Mull of Galloway, a reefed promontory, is the S point of Scotland.

Galls, growths caused on plants of various kinds by parasitic mites (Phytotritidæ). The mites are distinguished by the elongated body and by the loss of the third and fourth pairs of legs. The most familiar galls made by these pests are the so-called nail galls of the lime-tree, which are upright hollow columns in which the mites live. Somewhat similar galls are found on the sycamore, elm, maple, and various fruit-trees, and young buds of the currant are often spoilt by these mites. Oak galls or gall nuts were formerly extensively used in the manufacture of ink.

Galsworthy, John (1867-1933), English novelist and dramatist, wrote a great series of novels dealing with the history of an upper middle-class family from c. 1870 to the time of his death—



John Galsworthy

The Forsyte Saga and *The Modern Comedy*. The former comprises *The Man of Property* (1906), *In Chancery* (1920), *To Let* (1921), and two interludes, the latter, *The White Monk* (1924), *The Silver Spoon* (1926), *The Swan Song* (1928), and two interludes. *Caravan* (1925) is a collection of his best short stories. His plays, notable for their natural dialogue, deal mostly with social problems. They include *The Silver Box* (1906), *The Skin Game* (1920), *Strife* (1920), *Loyalties* (1922), and *Escape* (1926). His works are notable for their deep characterisation and sympathy with all classes, and are informed throughout by the outlook of the upper middle class which he described so perfectly. Many of his short stories were adapted for the stage.

Galt, Sir Alexander Tilloch (1811-1893), Canadian politician. He emigrated from England to Canada, became Liberal M.P. in 1849, and Finance Minister in 1869, promoting the federation of the provinces into a Dominion. He established tariffs against the decimal system of currency. Galt, who believed in the eventual independence of Canada, also represented the Dominion at international conferences.

Galt, John (1779-1839), Scots novelist, a friend of Byron, and a pioneer in Canada. Best known are his collections of letters and short pieces, *The Ayrshire Legatees* (1820) and *The Annals of the Parish* (1821). They are excellent pictures of the humours of life in a small Scottish town.

Galton, Sir Francis (1822-1911), English scientist. A cousin of Darwin, he was inspired by the latter's work and turned his attention to anthropology. He named and established the science of eugenics, made special investigation of colour-blindness, a defect from which he himself suffered, did valuable work in the field of criminology, investigated finger-prints, and evolved the composite photograph. He was knighted in 1909, two years before his death. He wrote *Englishmen into Human Faculty* (1883), among many other works.

Galvani, Luigi (1737-1798) physician and physicist born at Bologna where he became professor of anatomy in 1762. He made a study of birds and wrote works dealing with the sense of hearing. His name is chiefly remembered for the accidental discovery of the phenomenon called galvanism. He found that a scalpel that had lain near the pole of an electrical machine could convulse the muscles of a dead frog when it touched the body. This led Galvani to propound a theory that all animals have electricity in their nerves and muscles and he produced his book *Commentary on the Power of Electricity in Muscular Motion*.

Galvanizing the coating of iron and steel with zinc is one of the most useful discoveries of modern times. The process depends for its efficacy in protecting iron from corrosion by rust upon the fact that zinc is a more electropositive metal than iron (see **ELECTRO-CHEMISTRY**). Thus when the two are placed in contact and exposed to the action of water the zinc tends to be attacked the iron being polarised by hydrogen and so protected from oxidation. Zinc itself oxidises only slowly since the oxide forms a protective surface coating for the underlying metal. There are four methods used for coating iron the most effective being the *hot galvanizing process* in which the iron is passed through a bath of molten zinc. The zinc or spelter as it is termed is melted in an iron pot and the iron after thorough cleaning is dipped into it. The surface of the zinc is coated with sal ammoniac which causes the zinc immediately to wet the surface of the iron and alloy with it. The speed at which the sheets are passed through the zinc determines the weight of coating they receive this should be at least 2 oz per sq ft. but ordinary commercial corrugated iron is rarely of this high quality. The best quality of galvanised pure iron resists weather indefinitely.

Electrolytic galvanizing is now

claimed to afford equal protection from weather while the surface though not as bright is smoother than that of the hot galvanised material. It is particularly suitable for objects which would be affected by the heat of the bath such as steel springs. The deposition is always carried out from a zinc sulphate solution.

A process increasingly used to protect small parts from rust under not too severe conditions is known as *sherardising* from the name of the inventor Sherard Cowper Colles. It consists in heating the material in drums in the presence of metallic zinc dust. The result is a thin smooth coating which can be applied to parts of small machines electrical apparatus and locks after they have been finished to size.

The Schoop process of *metal spraying* in which a wire of the metal is fed into an oxy hydrogen flame and thus instantly volatilised in the form of a fine spray is being applied to galvanising but the contact between the zinc and the metal is less intimate than that given by other methods. It can, however be applied to iron and steel already in position.

Galvanism a use of electricity to alleviate pain. A current is passed through the body often of high voltage but low amperage.

Galvanometer see **ELECTRICAL MEASURING INSTRUMENTS**

Galveston city and port of Texas, U.S.A. on Galveston Island Gulf of Mexico is the most important cotton export port in the U.S.A. There are large iron foundries. A permanent causeway 4 m long connects Galveston with the mainland. Pop. (1930) 59,935.

Galway county of Connaught, Irish Free State bounded W by the Atlantic S by Clare E by King's County and Roscommon N by Mayo and Roscommon and S.E. by Tipperary and the Shannon. A broken sea-coast provides good harbours for the fishing industry. The climate is mild and it is customary for the cattle

to remain out all the year round, though fierce W winds are common. Large tracts of the country are barren, boggy, or mountainous (the Twelve Pins Group reaching a height of 2300 ft), but the E section contains good agriculture and farming land.

Galway is watered by the Suck, which forms its E boundary before uniting with the Shannon, the Clare, the Ballynahinch, excellent for salmon-fishing, and by Lough Corrib, which extends N from Galway Town. Black marble is quarried near Galway, red marble at Shantallow. Local manufactures include woollens and the famous Connemara hand-knit stockings. Apart from the capital, Galway



On the Galway Coast

(estimated pop 14,000), the only towns of importance are Loughrea and Tuam. Queen's College, now University College, was founded c 1845. The county is not rich in monuments, the Round Tower at Kilmaedduagh, 112 ft. high, and the castle at Tuam being the most important. Area, 2294 sq m (second largest Irish county), pop 169,000.

Gama, Vasco da, *see* DA GAMA, VASCO

Gambetta, Léon Michel (1838-1882). French statesman. He was called to the bar in Paris in 1859. Ten years later he was returned as deputy for both Belleville and Marseilles, sitting for the latter. He was prominent in the defence organisation during the siege of Paris, making a sensational

departure by balloon, to carry on the leadership from Tours. On the surrender of Paris he resigned and went to Spain, returning in 1872 to lead the Republican party. In 1879 he became President of the Chamber of Deputies.

Gambia, a small British dependency in W Africa, on the R Gambia. The colony proper occupies only 4 sq m and has a pop of c 10,000, but the protectorate covers 4130 sq m and has a pop of c 200,000. Administration is in the hands of a Governor and Executive, and a partly unofficial nominated Legislative Council. The capital, Bathurst, stands on the Island of St Mary, all the rest is governed on the Protectorate system. The climate is reasonably healthy for Europeans, the dry period being Dec-May, a variable rainfall, and a dry E wind between Dec and March.

Transport is confined to the R Gambia, a few motor-cars, and rough native carts drawn by long-horned cattle. Away from the beaten track are many wild animals. Gambia is not well wooded, only a few hardwood trees flourishing.

Except for the swamps the country is largely bush. The natives, Mandingo and Jola, Negro or Negroid, are hard-working and thrifty. There are a number of schools, elementary, vernacular, secondary, manual training, and one for teachers. The Wesleyans, Roman Catholics, and Mohammedans have special schools. There are detachments of the W African Frontier Force, and of armed police. The public debt is under £6000. The revenue for 1931 was £184,825, with imports standing at £252,613, and exports, £529,872. Imports are largely rice, oils, cotton-piece goods and tobacco, the outstanding export being ground-nuts.

Gambia was discovered by early Portuguese navigators during the 15th cent. In the 17th cent various merchants secured trading charters and established a settlement on the banks of the river. In 1843 Gambia was made an independent Crown Colony; in 1866 it formed part of the W. African

Settlements and in 1888 again became a separate Crown Colony

Gambling *see* GAMING AND WAGERING

Gamboge a gum resin which is obtained from a tree growing in the Far East especially in Siam and Indo China. It is obtained by making incisions in the bark and consists of c. 25 per cent of a water soluble gum and 5 per cent of resin. Gamboge is employed as a paint pigment and in the manufacture of varnishes also as a tanning material and as a purgative.

Gambrinus a legendary Flemish king the reputed inventor of lager beer. His name probably originated from that of Jan Primus (John I) Duke of Brabant (1251-84) who is portrayed in the Guildhall of the Brewers Guild at Brussels with a tankard in his hand.

Game Laws, the laws relating to the preservation of game and the punishment of persons unlawfully killing game (poachers). Until a century ago British game laws were extremely harsh and vindictive. Their effect however was not to suppress poaching but to encourage violence in resisting arrest. The 19th cent. saw a great change in public opinion. Poaching is no longer regarded as a heinous crime. The objects of the present-day game laws are besides the protection of rights of property the preservation of wild birds and the exercise of a strict control over the carrying of guns.

Game includes hares, grouse, partridges, pheasants etc. but not rabbits nor quail, snipe, woodcocks etc. but these latter may be taken only by persons possessing a game certificate. The right to take these birds or animals is vested in the landowner or the person to whom he has granted the right. Poaching or trespass in search of game by day is punishable summarily by a fine not exceeding £1 unlawfully (i.e. without a licence) taking game or rabbits by night in any land or on any highway, path or road or entering or being in any such place with any instrument for the purpose of

taking or destroying game is punishable with imprisonment or in the case of a third offence with penal servitude. Night time begins one hour before sunset and ends one hour after sunrise. Penalties are also laid down for various other offences such as unlawfully coursing, hunting or killing deer in an unenclosed part of the forest etc.

A licence is required by every person who hunts, shoots or takes game. But persons taking woodcock and snipe with nets or springs, proprietors or tenants on enclosed land, killing rabbits, persons hunting deer or hares with hounds etc. are exempt. Even where the quarry is not legally game a gun licence is required but a game licence covers a gun licence. Occupiers of land scaring birds or killing vermin (which does not include rabbits) do not require a game licence.

Game licences taken out between July 31 and Nov. 1 to expire on July 31 following cost £3. Licences covering the period July 31-Oct. 31 cost £1. A licence for a period of 14 days costs £1. Gun licences (which cover guns, air guns or pistols) cost 10s. *See also* ANIMALS, CRUELTY TO, FIREARMS.

Games, Greek. Athletic contests held regularly in ancient Greece were solemn festivals partaking of the nature of religious ceremonies of thank-offerings to the gods or funeral rites in honour of some ancient hero. They were 4 in number.

(i) *The Olympic Games* were held at Olympia in Elis, Peloponnesus. They are said to have been instituted by Hercules in honour of Olympian Zeus and to have been revived by Iphitus in 756 B.C. Thenceforth they were held every 4 years without a break until A.D. 393. Their importance is seen in the fact that the Greek calendar was reckoned in Olympiads or periods of 4 years. For detail *see* ATHLETIC SPORTS. At a later period competitions in music and poetry were introduced.

(ii) *The Isthmian Games* so called

from the Isthmus of Corinth, where they were held, were founded in 523 B.C., and were held in the 1st and 3rd year of each Olympiad. Their institution is variously attributed to Poseidon, to Sisyphus, and to Theseus. The contests resembled those at Olympia, except that the victor received a crown of wild parsley. The games were managed by the Corinthians until the sack of Corinth in 146 B.C., when they were taken over by the Sicyonians. It was at the Isthmian games that Flaminius in 196 B.C. and Nero in A.D. 67 declared the freedom of Greece (see GREEK HISTORY).

(iii) The *Nemean Games*, named after the city of Nemea, in the Argolid, date from 516 B.C., and were held every 2 years. The prize was a crown of wild celery (or a pine-wreath).

(iv) The *Pythian Games*, instituted in 527 B.C. in honour of Pythian Apollo, were held at Delphi every 4 years. The prize was a wreath of laurel. They were originally limited to musical competitions.

Many of the victors at these games were celebrated by Simonides and Pindar (q.v.). Pindar wrote 44 Odes of Victory, divided into 4 books corresponding to the 4 games. The victors received special privileges and on their return home they entered their cities through breaches in the walls specially made for them.

Gametes are cells taking part in sexual reproduction. The female gamete is the egg-cell or ovum. The male gamete of animals is the spermatozoon, and the motile male gamete of plants, the spermatozoid. The gametes of most of the flowering plants are non-motile, and consist merely of a nucleus (q.v.) with a small amount of accompanying cytoplasm, formed in the pollen grain. In some of the lower plants and animals there is no physical distinction between the two gametes, nor between the individuals producing them, and consequently they cannot be described as male and female, although the reproduction is still described as

sexual. Generally the female gamete is larger, well stored with food for the development of the embryo, and consequently passive. The male gametes are generally very numerous, smaller, without food store, and very active, frequently having to move some distance to reach the female gamete.

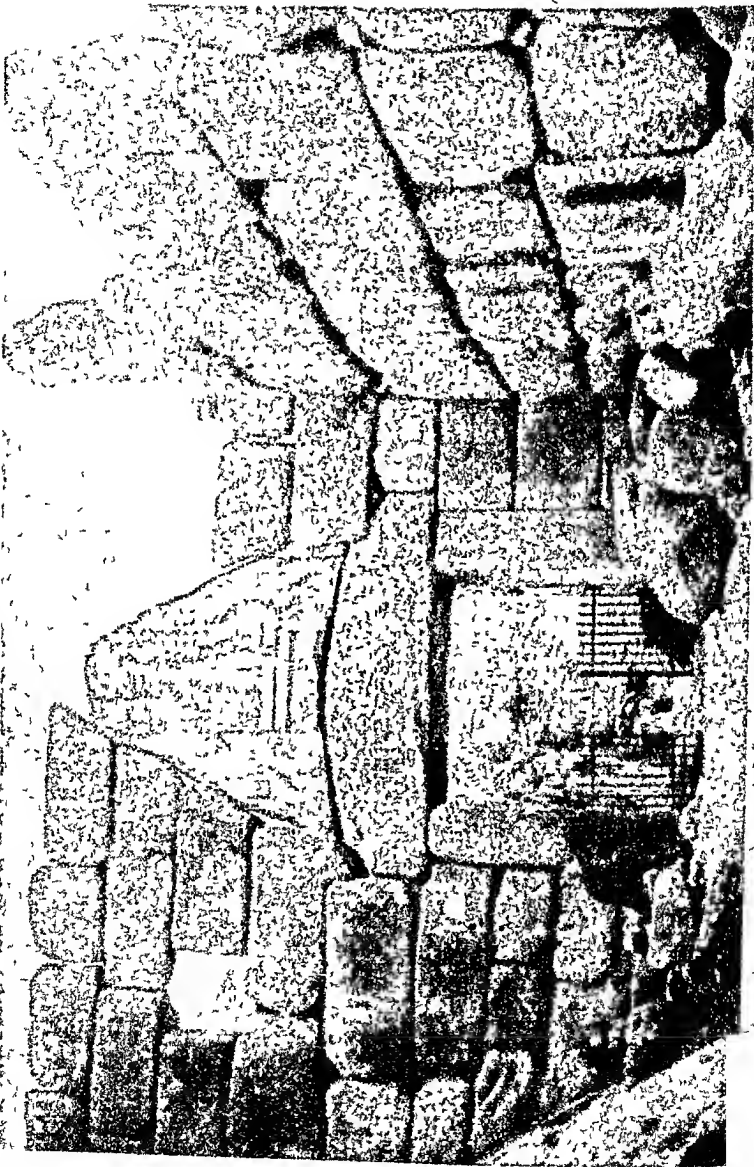
Although fertilisation is usually essential for development, unfertilised egg-cells of certain insects, a few flowering plants, and of lower plants and animals may develop into new individuals, a phenomenon described as parthenogenesis (q.v.). See also CELL, GENETICS, HEREDITY, SEX.

Gaming and Wagering. A wager is a promise to give money or money's worth upon the determination or ascertainment of an uncertain event, its essence being that one party is to win and the other to lose. In England wagers, unless indecent or contrary to public policy, were formerly legal, so that in 1771 Lord Mansfield heard without protest an action on a wager by which two young men agreed to run their fathers against each other, i.e. to bet on the duration of their fathers' respective lives. By the Gaming Act, 1845, all contracts by way of gaming or wagering are void, and no action can be brought to recover what has been won. Prizes awarded to the winner of a lawful game or sport are excepted, e.g. golf trophies. Collateral agreements have been rendered void by a series of statutes; thus, money lent for the purpose of gaming cannot be recovered, though money lent for the purpose of paying bets is recoverable.

Under the criminal law gaming is not in itself an offence, but gaming at any unlawful game is unlawful, the penalty being a fine not exceeding £50, while those setting up the game in question are liable to a fine of £200. Further, it is unlawful to keep, or play games in, a common gaming-house, which may be defined as a house, whether public or private, in which a number of persons are invited habitually to congregate for the purpose of unlawful



EL RELO THE DIVI TMENTM OF CHRIST



THE LION GATE MYCENAE GREECE



Ganymede [GA NIMED] in classical myth a beautiful young prince son of Dardanus (or Tros) carried away by an eagle to Olympus where he became cup-bearer to Zeus in the place of Hebe. Many sculptures and paintings portray him riding, or being carried by the eagle.

Garbo Greta (b 1905) real name *Gustafsson* was born at Stockholm. After appearing in Sweden as a dancer she went to Hollywood and was an immediate screen success.



G : Garbo.

starring in *The Temptress Mata Hari*, *Grand Hotel*, *As You Desire Me* and many other films she became a leading actress of the Metro-Goldwyn Mayer Corporation. Though there have been several rumours of her retirement from the screen, she signed a new contract in 1933.

Garcia, Manoel (1775-1832) famous Spanish tenor and singing master who became celebrated throughout Europe and America. Besides his eminence as a singer he was also a composer of operas and an impresario. His son, Manoel, was a famous singing

teacher who taught Jenny Lind and who invented the Laryngoscope for the examination of the larynx. His two daughters were the singers Malbran and Pauline Viardot Garcia.

Gard, department of S France area 22 0 sq m pop 406 806. The Rhône its principal river forms the E boundary with the Mediterranean in the S. In the NW the Cévennes reach a height of 5120 ft while in the extreme S are large stretches of marsh land yielding a considerable amount of salt. Gard is rich in minerals—coal, iron, copper and zinc, and noted for its wheat, rye and oats. Mulberries and olives also flourish. Among the principal towns are Alais where the silk industry is important. Nîmes the capital, Beaucaire, Uzès and Bessèges. The Pont du Gard a famous Roman aqueduct crosses the R Gard near Remoulins.

Garda, Lake of, is situated between Lombardy and Venetia and penetrates slightly into the Tirol. It is some 34 m long with a varying width from 3 m in the N to 10 m near Desenzano in the S. In area it is 143 sq m and in parts it reaches a depth of nearly 1000 ft.

Garden Furniture furnishings designed specially for use in the garden. One or two deck-chairs costing a few shillings and a low table are all that are necessary. The chairs are of many models in one a movement of the body tilts the chair to any position from horizontal to upright some have foot rests and a small canopy sun shield. A combined tray table and book rest which remains level at any adjustment of the chair is an innovation. One chromium plated steel chair folds twice to a very compact size. Other plated steel furniture for the garden or logia includes tables with wooden tops and upright arm-chairs all extremely durable. The older painted iron furniture is still used notably folding tables and tables with a large tilting umbrella of up to 6 ft. spread. Garden chairs with a hinged flap for use as a table are very practical.

as are those convertible from a comfortable seat for two into an arm-chair for one. The couch hammock, well-upholstered, may cost £5 5s. Swinging hammocks may be slung between posts sunk in cement, if trees are not available. For sun-bathing or lounging there are folding lounges covered in patterned canvas or green rot-proof material, secured to a wood frame with an adjustable head-rest, they cost £28s. Lawn mattresses are cheaper. They are covered with cretonne, have a mackintosh water-proof back and are easily rolled up.

For serving meals in the garden there is a special trolley wagon with three tiers, the top detachable as a tray. It is made of cane with double handles and rubber-tyred wheels. Tray stands which fold flat with one movement made in oak or having a coloured finish, and folding tea stands with laminated wood trays finished with weather resisting cellulose lacquer are useful. Cane, wicker and fibre chairs, etc., produced in many colours, can be used in the lounge or bedroom during winter. Oak and eucalyptus chairs are very durable and may be left outside in any weather. Though teak is more expensive for furniture than some other woods, it is extremely durable and has been for seats, chairs, and tables. A good example is a table with a set of four chairs of 'corner' shape to sit under it.

Gardenia is a shrub with thick, dark green, glossy leaves and white, strongly scented flowers. It belongs to the Rubiaceae (madder) family and has got its name from the gardenia which is a shrub with thick, dark green, glossy leaves and white, strongly scented flowers. It belongs to the Rubiaceae (madder) family and has got its name from the gardenia which is a shrub with thick, dark green, glossy leaves and white, strongly scented flowers.

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success. In a new garden, the first task should always be to dig a hole 3 ft deep to see the earth in which the plants are to be placed. A heavy soil is unfortunately that most often found in small gardens, and usually consists of a stiff heavy clay. This can be much improved by deep digging several times through the winter exposure of a clay soil to frost considerably lightens it. All the vegetable rubbish of the house and garden should be burned and the ashes dug into it, and sand or road sweepings added. Road sweepings are the best possible remedy for heavy soil, many local councils will supply a cartload at a trifling cost.

A *loamy soil* consists of sand and clay mixed preferably in the proportion 2:1. It is the most easily worked soil, and best of all for garden purposes when some 2 ft thick, with a clay subsoil. *Peat* is composed chiefly of dead matter and is found only where there were formerly woods. It is difficult to manage but extremely rich, and can be made easier to work by the addition of loam, which is usually easily obtainable. *Sandy soil* is composed of minute particles of granite and quartz and other rocks, and is rather unproductive as a garden soil, because it cannot retain moisture. The best remedy is to add clay and horse or cow dung and vegetable matter.

Lay out of Gardens It is important to discover which side of the garden enjoys sunshine for the greatest number of hours a day, and to make the good side border front and to end it. The rest of the garden should be planned according to its size and the uses to which it is to be put. Straight beds and parallel paths should be avoided if possible, and the paths of trees and shrubs should be made if possible for height and for the wind. Small dwarfing trees such as Laburnum and Lonicera should be placed in the border up to a 4 ft distance from the paths. The paths should be made of stone or concrete, and the borders should be made of earth or concrete. The paths should be made of stone or concrete, and the borders should be made of earth or concrete.

and paths should be marked out when the plan is made by lengths of string pegged to the ground. A circular bed can be made by inserting a central peg to which is tied string of the required radius with which a circle is described. To make paths the soil should be removed to the depth of at least a foot, the trench refilled with a layer of rough stone or rubble and then coarse gravel spread upon it and fine sand and gravel rolled in constantly till a firm hard surface is obtained. To divide a border from a gravel path thin strips of wood should be nailed to pegs along the length as this prevents the surface soil of the borders from spoiling the gravel paths during heavy rains.

If the lawn is to be used for games such as tennis or croquet it must be levelled otherwise even a small garden can be attractively planned on different levels or to rise or dip away from the house.

To make a Lawn. Good turf can be bought in rolls 1 ft wide and 1 yard in length, and provides one of the easiest ways of making a lawn. A spell of mild weather during the winter should be made use of and the turves ordered and laid quickly. The soil should be dug over and watered if necessary the turves unrolled laid exactly side by side and end to end and lightly beaten down. Seed should be sown in the autumn on prepared and enriched soil which has been carefully levelled. The seed should be scattered thickly and evenly on a still day (1 lb of grass seed is used for 16 sq yds) and covered with a sprinkling of soil. The grass blades appear after some weeks and should be cut extremely carefully at first.

The Flower Beds. The amateur gardener should plant with a colour scheme in view a succession of flowers almost throughout the year can be obtained even in a small garden with but a little forethought. He should also distinguish between flowers suitable for cutting and house decoration and those producing most

A delightful flower garden can be made quickly and inexpensively from seeds which can be bought in packets for a few pence. Usually it is well even at a slightly greater cost, to obtain them from the firms whose names are household words because the viability of their seeds is guaranteed and this may save many disappointments. These firms gladly advise a customer about the plants most suitable for his soil and give him technical details as to the best methods based on the long experience of the firm. Hardy annuals can be sown where they are to flower and these are often the most useful plants for an amateur who wants to transform the ground around his house quickly into a gay garden through March April and May he can sow white and rose candytuft golden yellow and dark red corceps orange cheiranthus clarkias of all colours rose blue and white convolvulus to climb on trellis work orange and crimson and carmine cescholtzia golden erysimum white gypsophila satiny textured scaler and rose and pink godetias violet and blue larkspur blue flax love in a mist the scented pale-yellow evening primrose annual poppies single and double of many colours and white crimson scarlet and violet annies. The seeds of these plants should be sown in patches rather than in rows the size of the patches depending on that of the garden a dozen plants of the same kind and colour is a good average. As a rule in a small garden it is better to buy seeds of a single colour rather than the popular mixed packets. The white or rose tree mallow is a handsome plant 4 ft. high, and an excellent and showy plant to grow in borders or shrubberies and ornamental grasses are quickly growing, tall plants which give some height in a garden of annuals.

In the autumn seed of gold and red and the less usual purple wallflowers should be sown for early flowering the

following spring Sweet peas also are best sown in autumn

Perennial plants may be grown from seed or bought as roots. The perennials which may be grown in any garden are innumerable, and a plant grower should be consulted as to those most suitable for the particular soil and climate

Gardening, Indoor. If the room or passage is lighted by gas, the number of plants that can be grown is limited to such plants as the aspidistra or parlour palm, the indiarubber plant, aralia, New Zealand pine, etc. A larger number of foliage plants can be grown where no gas is used (the poisonous action of gas is brought about by small escapes of unit gas into the air), including the handsome elephant's ear begonia with its marbled leaves and the long grassy leaves of miscanthus and isolepis, and the pistol plant, with its feathery green leaves and tiny flower-buds, which burst explosively to scatter a shower of pollen like a tiny smoke-cloud

Many flowering plants succeed indoors with a little care, such as the evergreen genistas, shrubby azalea and deutzia, and arum, begonia, calceolaria, dicylra, fuchsia, lily of the valley, musk, pelargonium, and Solomon's seal. Certain annuals, such as cinerarias, petunias, and mignonette also repay use for indoor decoration. The annuals are as a rule best bought when about to flower, and require occasional feeding with liquid manure and sufficient water, and to be kept free from insects and dust. The shrubby plants all need careful watering, and must never be allowed to become dry, straggly shoots of perennials are shortened in Feb and unwanted shoots or buds are pinched out, liquid manure being given in dilute form weekly, most plants require repotting every year, in the autumn

Gardiner, Alfred G (b 1865), "Alpha of the Plough," English essayist and journalist. His *Prophets, Priests, and Kings*, *Pittars of Society* (1913), and *War Lords* (1915) contain satirical sketches of contemporary political

figures. He contributed regularly to the *London Star*, and was editor of the *Daily News*, 1902-19

Gardiner, Samuel Rawson (1829-1902), English historian, best known for his accounts of the Civil War and the Protectorate, written in a learned yet clear and unbiased manner. Much knowledge of this period is due to his researches. His books include the *History of the Great Civil War* (1886-91), *History of the Commonwealth* (1895-1901), *Oliver Cromwell* (1901), and *Student's History of England* (new ed 1920)

Gardiner, Stephen (c. 1484-1555), Bishop of Winchester (1531). Born at Bury St Edmunds, he studied canon and civil law, and entered the service of Cardinal Wolsey. His main work lay in diplomacy, until in the reign of Edward VI he opposed strenuously the progress of the Protestant reformation in England. He was imprisoned in the Tower during the last 5 years of this reign. Queen Mary restored Gardiner and appointed him Lord Chancellor

Gardner, Ernest Arthur (b 1862), British archaeologist, Director of the British School at Athens (1887-95) and Professor of Archaeology at University College, London (1896-1929). He excavated many sites in Greece, and has written many works on Greek art and kindred subjects

Gardner, Percy (b 1846), British archaeologist, brother of E A Gardner (q v). Professor of Classical Archaeology at Oxford 1887-1925. His works include *New Chapters in Greek History* (1892), *New Chapters in Greek Art* (1926), and many publications on Greek coins

Garfield, James Abram (1831-1881), 20th President of the United States. He was born at Orange, Ohio. He graduated at Williams College, Massachusetts, after a struggle against poverty in his boyhood, and began to practise law. He distinguished himself in the Civil War, and later entered politics, becoming one of the Republican leaders. He was elected President

in 1831 after a stormy campaign his presidency which was inaugurated in March lasted only until July the same year when he was assassinated by a madman at Washington.

Gar-fish (or *Gar Pike*) a name applied to two very distinct fishes superficially alike in having the jaws long slender and beak like. One is found in the rivers and lakes of the U.S.A. and has close fitting ganoid (*gu*) scales. It may reach a length of 5 ft. and is of economic value as a food fish and when immature as a destroyer of vast numbers of mosquito larvae. The other is a marine fish related to the flying fish but without the long flight fins. It is an edible fish found in British waters and is unmistakable from the green colour of its bones.

Gargantua [GAHGA NTŪŪ] see RABELAIS

Gargoyle, a form of projecting waterspout used in Gothic architecture often carved into a grotesque representation of a human or animal figure. The water escapes through the mouth. The gargoyles (*chimères*) of Notre Dame Paris are famous examples.

Garibaldi, Giuseppe (1807-1882) Italian patriot born at Nice. As a young man he was condemned to death for his share in the abortive Genoa revolt of 1834 but he escaped to S. America returning to lead the defence of the Roman republic against the French and Austrians and conducting the subsequent retreat. Four years passed in exile in the U.S.A. then in 1854 he returned to Capri, Sardinia and in 1859 he fought for Sardinia against Austria. In May 1860 he landed at Marsala and after defeating the Neapolitan forces at Calatafimi and Milazzo proclaimed himself dictator of Sicily in the name of King Victor Emmanuel. He next crossed to the mainland and made himself dictator of Naples. In Nov. 1860 he entered Naples with Victor Emmanuel, handing over his authority to the King. In 1860 he was wounded at Aspromonte in a raid on Rome. In

the Seven Weeks War (1866) he led a volunteer army against Austria and in the Franco-Prussian War (1870-71) he assisted France with a volunteer corps. In 1874 he was elected deputy for Rome. Garibaldi is regarded as one of the creators of united Italy.

Garlic, a plant belonging to the family Labiaceæ with a fleshy bulbous root, a rosette of radical ovate parallel veined leaves and an umbel of white flowers. The flowers are often found in woods and shady lanes in early June. The whole plant is pervaded with the characteristic onion like smell and the bulb is used for flavouring.

Garnets, a group of silicates exhibiting uniform characters and crystallising in the cubic system. Their colour varies with their composition from a tinge of grey to yellow, red, violet, green and black. Their size ranges from a grain of sand to c. 4 in. in diameter. Garnets are found especially in metamorphic rocks also in lavas and granites.

The chief kinds of garnet are Grossular, Pyrope, Almandine, Spessartite (or Spessartine), Andradite and Uvarovite. Melanite is a dark variety of Andradite.

Grossular silicate of calcium and aluminium is pale olive green in colour and is characteristic of altered impure limestones. A cinnamon coloured variety from Ceylon is a fairly popular gem and is called Cinnamon Stone. Pyrope, magnesium aluminium silicate, a deep red in colour and highly prized as a gem but is never found pure. It is found in lavas or serpentines in Bohemia and Saxony in detrital deposits in Ceylon, and associated with diamonds in S. Africa where it is called the Cape ruby. Almandine silicate of iron and aluminium is dark red to brownish red in colour and is often found in metamorphic rocks or in granites. It is sometimes known as precious garnet. "Common garnet" is a variety of almandine brownish red to opaque. Spessartite

manganese aluminium silicate, is red, brown, or violet coloured, and found in granites and andesites. It is one of the rarer garnets. *Andradite*, often confused with almandine, and, like that mineral sometimes called "common garnet," may be red, brown, yellow, or green, the last being a gemstone. In composition it is silicate of calcium and iron, and is a constituent of various metamorphosed limestones. *Melanite* is a black variety found in lavas. *Uvarovite*, calcium chromium silicate, is a rare garnet of emerald-green colour found especially in the Ural Mountains.

Garnets, known to the ancient Egyptians, who formed necklaces of the stones, were used by the Romans and the Anglo-Saxons, who inlaid them into mosaics. They were formerly known as carbuncles, a name still given to garnets cut in a special fashion. The comparative frequency of their occurrence is due to their being much harder than most of the beds which contain them, and hence they are preserved when the rock is disintegrated. See also GEM.

Garnett, David (b 1892), English novelist, is the author of *Lady into Fox*, for which he received the Hawthornden Prize (1923), *Go She Must I*, *No Love*, *A Rabbit in the Air*, *Pocahontas* (1932), and other novels of high literary merit and unusual style.

Garnier, Jean Louis Charles (1825-1898), French architect. He won the Grand Prix de Rome at the age of 23, travelled in Italy and Greece, and in 1853 returned to Paris with a considerable reputation. In 1861 he designed a grand opera house for Paris, which took 14 years to complete. He also designed the Hôtel du Cercle de la Librairie in Paris and the Casino at Monte Carlo. In 1895 he was made a grand officer of the Legion of Honour. He was probably the greatest European architect of his time.

Garnier, Marie Joseph François (1839-1873), French officer and explorer. He joined the Navy and was sent to Brazil and then to Cochun-China. He paid a second visit to Cochun-China,

when he was the actual, though not the nominal, leader of an exploration party into almost unknown country. His superior officer died while on the expedition, and Garnier became leader. He returned to France, and helped to defend Paris during the siege in 1870. He again revisited Cochun-China, passing on to China, and exploring the Yang-tsze-Kiang. He was killed in 1873 while trying to establish a French protectorate in Tong-king.

Garnishee, see EXECUTION.

Garonne, river in S.W. France, rising in the Spanish Pyrenees, and emptying itself into the Bay of Biscay, length 404 m., it is navigable for c. 100 m. It joins with the river Dordogne to form the estuary of the Gironde. The chief towns on its banks are Toulouse, Agen, and Bordeaux.

Garrick, David (1717-1779), English actor, born at Hereford, he accompanied Samuel Johnson to London in 1737, and after an unsuccessful venture as a wine-merchant, made his first



David Garrick.

appearance on the stage *incognito* at Goodman's Fields in 1741, and achieved fame by his performance of Richard III. He acted at Drury Lane from 1742 to 1745, from 1745 to 1746 he was joint-manager of the Theatre Royal, Dublin, with Sheridan, from 1746 to 1747 he was at Covent Garden, and in 1747 purchased a two-thirds share in Drury Lane Theatre, which he continued to manage till 1776. Garrick excelled equally in tragedy, comedy, and farce, and was a pioneer of "naturalistic" acting. He was the author of several plays, including *The Lying Valet* (1740), *The Guardian* (1767), etc., and also made adaptations from Shakespeare and others. His

great collection of plays was bequeathed to the British Museum

Garrison, Wm. Lloyd (1803-18 9) American Anti Slavery leader worked as a journalist in Massachusetts joined Lundy (1829) in movement for abolition of slavery in the United States and founded the *Liberator* (1831) Visited and won support in England (1833) Suffered persecution by slave-owners on his return He was President of the American Anti Slavery Society (1843-60) when on the conclusion of the Civil War slavery was abolished His sons W P and F J Garrison wrote his *Life* (1889)

Garrotte (Span for cudgel) a device used in Spain and Portugal for the execution of criminals The condemned man is strapped to an upright post and the back of his neck being smartly struck by a rod his spinal column is dislocated *Garrotting* is a form of robbery with violence the criminal throttling his victim from behind It was very prevalent in England in 1862 and an Act of 1863 imposed flogging for this offence in addition to penal servitude

Garshin, Ysserold (180-1888) Russian author some of his works e.g. *The Signal* (1912) *The Conard* (1889) and *The Red Flower* (1890) are available in English translations.

Garter Order of the one of the world's most illustrious orders of chivalry instituted by Edward III c 1350 under the special patronage of St George the good knight The insignia comprise a garter of dark blue velvet and gold with the motto *Honi soit qui mal y pense* a mantle of blue velvet with a silver eight pointed star embroidered on the left breast a hood and surcoat of crimson velvet a hat of black velvet with a plume of white ostrich and black heron feathers a gold collar the George (enamelled figure of St George and the dragon) suspended from the collar and the Lesser George (badge suspended from the left shoulder by a dark blue ribbon and worn over the right hip) The Order consists of the

Sovereign and 11 knights Companions its officers are the *Prelate* the *Chancellor* the *Registrar* the *Herald* the *Carter* *King-of-Arms* and the *Ushe of the Black Rod* The Knights meet in the choir of St George's Chapel Windsor Castle where each has his stall and the stall plates of the knights remain permanently

Garvise Charles (d 18 0) English novelist He is said to have written more than 60 books and had the largest following of his time His style was essentially popular and his genuine gift of story telling coupled with a remarkable industry brought him into the front rank as a best seller

Garvin, James Louis (b 1868) British journalist Editor of the *O'Clock* (1900) *I'll Tell Gaiette* (1910-11) and *Observer* (since 1908) and chief Editor of the *Cyclopædia Britannica* (13th and 14th editions) His publications include a *Life of Joseph Chamberlain*

Gas, Natural, see **LUXES**

Gas Analysis is normally conducted by measuring a sample of the gas exposing it to the action of reagents to absorb certain constituents and again measuring the volume. Samples of gas for analysis are collected whenever possible in glass tubes which may be closed at one end drawn off to a narrow capillary at the other end exhausted by a pump and then sealed off the capillary is broken so that the gas to be sampled rushes into the vacuum and the tube is then sealed The most convenient method of handling gases is to confine the gas in a glass vessel over a liquid In a great many cases water may be used and the simplest form of gas analysis apparatus is that invented by *Hempel* and shown in fig 1 The gas burette consists of a graduated tube joined at the bottom by a rubber tube to a similar ungraduated tube and closed at the top by a piece of rubber tube and a pinch cock the rubber tube being continued by a piece of capillary glass tubing Sufficient water is poured into the two tubes to half fill them when the ungraduated tube is raised and the pinch

cock opened, the whole of the gas may be driven out of the burette, and if this is then connected to a vessel containing the gas to be analysed, sufficient of this may be drawn into the burette as required.

In order to determine the amount of gas in the burette, it is necessary to move the ungraduated tube up or down until the liquid in it is at the same level as that in the burette. The pressure of the gas in the burette is then the same as that of the atmosphere, and its volume is read off on the graduations. The observed volume is usually corrected for the effects of temperature, barometric pressure, and vapour pres-

combustion, and exploding the gas by an electric spark in an explosion pipette. For further details of this type of gas analysis, a work on the subject must be consulted.

In dealing with very small quantities of gas, it is usual to employ pumps capable of producing very high vacua. The nature and purity of a gas is most readily determined by examining the spectrum formed by the discharge of a high-tension electric current at low gas pressure. The measurement of volume may be performed by forcing the gas, confined over mercury, into a very fine glass tube, but methods now exist by which exceedingly low gas pressures can be measured. Research stimulated by the development of the electric-incandescent lamp and the wireless valve, has led to the development of methods exceeding in delicacy any other branch of chemical analysis.

A very important branch of the subject is concerned with the analysis of the gases resulting from the combustion of fuel of various kinds (flue gas). The composition of this gas indicates whether the furnace is being supplied with the correct amount of air or not. Since the fuel used consists mainly of carbon, the percentage of carbon dioxide in the flue gas is almost a sufficient indication of whether or not combustion is proceeding correctly, but it is frequently supplemented by an estimation of carbon monoxide, which, of course, should not be present if combustion is complete. The carbon dioxide is easily absorbed by caustic soda, and excellent automatic flue-gas recorders are made which continually collect from the chimney a sample of gas of a certain volume, act on it with caustic-soda solution, and record the contraction in volume. Since these instruments require to be put into the hands of unskilled persons who find even the simple manipulations difficult, many devices have been invented and widely used which depend upon a physical property of the gas to indicate its composition. This is possible, since the only variable is the amount of

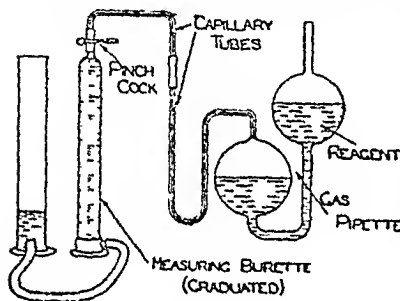


FIG 1

sure of the water, prevailing at the moment of measurement.

In order to remove any particular constituent, the gas is forced out of the burette into a gas pipette containing a reagent which absorbs the desired constituent. Such a pipette is shown in the figure. When the necessary reaction has occurred, the gas is drawn back into the burette and its volume again measured. This simple apparatus shows the principle on which more elaborate devices are based. The reagents used to absorb various gases are as follows: oxygen is absorbed by alkaline pyrogallol, carbon dioxide by caustic soda, and carbon monoxide by ammoniacal cuprous chloride. Hydrogen is usually determined, together with other combustible gases, by adding sufficient oxygen for

carbon dioxide. One popular form is based on the fact that the conductivity for heat of carbon dioxide is 40 per cent greater than that of air. Carbon monoxide and methane the only other gases present with the exception of sulphur dioxide which is removed from the gas before testing. The apparatus consists of two identical electric resistances of very fine platinum wire heated by a small constant current. The resistance of platinum increases with temperature and the difference in resistance of the two wires can be automatically recorded. This difference is zero when the two wires are exposed to the same cooling conditions. It is surrounded by gas of the same conductivity if the one is exposed to the furnace gas and the other to air at the same temperature the amount of carbon dioxide in the former can be deduced from the difference in resistance of the two wires. This is recorded automatically. The carbon dioxide can also be determined by apparatus which measures the viscosity of the gas its refractive index or the effect of its absorption upon the conductivity of ammonia.

An important case where the pollution of air may have serious consequences is in coal mines where methane (CH_4) is given off and may give rise to dangerous explosions. Many devices have been proposed to give warning of its presence but so far none has been universally adopted. One ingenious device consists in blowing one of two whistles tuned to the same note with the air of the mine and the other with pure air. If methane is present the pitch of one is changed and beats are produced. The miner judges the state of the air by the condition of the flame of his lamp.

Gascoigne, George (1630?–1677). English dramatist and poet was one of the great innovators in English literature. His *Steel Glas* (1676) was the first regular satire and his *Supposes* (1680) a translation of Aristophanes' *I Suppositi* was the first prose play in English. His tragedy

Jocasta (1666) was one of the first written in blank verse. His shorter poems appeared under the title *A hundred Sundrie Flowres bound up in one small Poem* (1572).

Gascony, an ancient province of SW France. It took its name from the Vascones a Spanish people who settled here at an early period and were subdued by the Franks in 602. It passed under English rule (1154) and became the subject of frequent strife between England and France until finally annexed by the latter (1453). The district is now divided up among the departments of Haute-Garonne, Lot-et-Garonne, Tarn-et-Garonne and Ariège.

Gas Engines, see INTERNAL COMBUSTION ENGINES.

Gases, Liquefaction of. In the article GASES PHYSICAL PROPERTIES OF the facts upon which the possibility of liquefying gases depend are given.

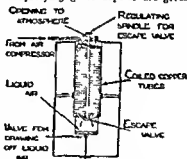


FIG. 1

Every gas becomes liquid at atmospheric pressure if sufficiently cooled and this is the method adopted in liquefying the so-called permanent gases such as oxygen and hydrogen. If it expands without doing work, cooling takes place when the gas is below a certain temperature. With air this temperature is c. 100° C and hence air may be liquefied by an extremely simple device first invented by Linde in Germany and Hampson in England in 1865. In Hampson's apparatus,

illustrated diagrammatically in Fig 1, the air is pumped by a compressor to c 200 atmospheres, and passes down through a set of 4 long similar fine copper pipes which are closely wound together in a spiral. These all run at the lower end into an adjustable escape valve, at which the pressure of the air is reduced to atmospheric. The air then passes upwards over the outside of the copper coils, cooling the air passing down inside the tubes. This results in the initial small drop in temperature at the escape valve rapidly building up until the air liquefies, when this process is established, between 8 and 9 per cent of the air pumped in is obtained in the liquid form. In Linde's apparatus the air is not allowed to expand to atmospheric pressure, but to an intermediate pressure, it can be shown that this results in a considerable saving in the energy used.

The liquefaction of hydrogen is accomplished by the Joule-Thomson effect, but this does not effect cooling until a temperature of -73°C is reached. It is therefore necessary to cool the gas by means of liquid air before allowing it to expand. Liquid hydrogen is now made use of on a commercial scale, and in the meantime application of similar methods enabled Onnes to liquefy and solidify helium, which boils at -268.9°C . By means of it temperatures within a fraction of a degree of absolute zero have been reached. The attainment of these extremely low temperatures has led to many remarkable discoveries, among which that of super-conductivity ($q v$) is the most extraordinary. But the commercial application of very low temperatures is also developing in a number of directions. The use of the rare gases of the atmosphere for the construction of advertising light, signs, and other purposes, has led to the establishment of air-liquefaction plant on an enormous scale, producing millions of cubic feet annually. The use of liquid oxygen as an explosive (see BLASTING) is rapidly developing

See Ewing, *The Mechanical Production of Cold* (London, 1921)

Gases, Physical Properties of. Gases fill uniformly any vessel in which they are placed, and do not form a free surface. The first part of this statement applies strictly only to very small vessels, for since a gas possesses weight, the pressure at the bottom of a vessel containing it is greater than that at the top. In all ordinary dealings with gases, we may, however, neglect this, and look upon a gas as an elastic fluid of uniform density. The explanations of its properties in terms of its molecular constitution will be found in the article KINETIC THEORY OF MATTER. Here we shall simply state the chief gas laws, as they are called. *Boyle's Law* states that the pressure multiplied by the volume of any given weight of gas is constant at any given temperature. *Gay-Lussac's Law* states that this product of pressure and volume varies as the absolute temperature of the gas. These two laws are summarised by the fundamental gas equation $PV = RT$, where R is what is called the gas constant. This equation refers to what is called a *gramme-molecule* of any gas, this being a quantity of gas having a weight in grammes equal to its own molecular weight. According to *Avogadro's Law* (see CHEMISTRY), equal volumes of all gases contain the same number of molecules, hence a *gramme-molecule* of any gas occupies the same volume at the same temperature and pressure, thus the constant R is the same for all gases.

Gay-Lussac's Law was first discovered in the form that the pressure of a gas kept at constant volume, or the volume of a gas kept at constant pressure, varies by $\frac{1}{273}$ of its pressure or volume at 0°C for every degree change of temperature. This leads to the conclusion that its pressure or volume will become zero at -273°C . For this reason, it was assumed that a body reduced to this temperature would contain no heat at all, in other words, would be at *absolute zero*. This

conception is of the greatest importance in thermodynamics (§ 1.)

In point of fact, no known gas follows the laws which we have just stated with absolute exactness though helium approaches very closely indeed to being a perfect gas until its temperature is reduced to within a few degrees of absolute zero. All other gases become liquid long before this temperature is reached and show considerable deviations from the simple gas laws when their pressure is increased. In the article on HEAT it is explained that for each gas or vapour there exists what is called a *critical temperature* below which the gas liquefies if its pressure is sufficiently raised. When the pressure is very small the volume will be great as the pressure is increased the volume will decrease until quite suddenly the gas begins to liquefy. At this point attempting to increase the pressure will result only in decrease of volume more and more gas liquefying as the volume is decreased.

The pressure is now the *vapour pressure* (p_v) of the pure liquid and this does not depend on the amount of liquid or vapour present. If we proceed further to reduce the volume we come to a point at which the little space left is completely filled with liquid whereupon since liquids are highly incompressible a very small diminution in volume will require an enormous increase in pressure. Ordinary gases deviate from the gas laws before their temperature is reduced below the critical temperature and the tendency is to approximate towards the type of curve exhibited by a gas below the critical temperature. These peculiar curves are represented by what is known as *Van der Waals equation* which is further discussed in KINETIC THEORY OF MATTER.

Another consequence of the fact that gases do not exactly obey the gas laws is known as the *Joule Thomson effect*. When a theoretically perfect gas is compressed no energy is stored in the gas if it is kept at a constant tempera-

ture the whole energy employed in compression appears at once as heat. When such a perfect gas is allowed to escape under pressure from an orifice no energy is therefore set free and the temperature of the gas after escaping is not changed. But an imperfect gas will be either heated or cooled slightly and this fact is of the highest theoretical and practical significance since it renders possible the liquefaction of gases which could otherwise be liquefied only with great difficulty (see GASES LIQUEFACTION OF).

Gases have two *specific heats* one at *constant pressure* and the other at *constant volume*. Since the gas when heated at constant pressure expands against some external force which is maintaining the pressure it does mechanical work and heat must therefore be absorbed. Hence the specific heat at constant pressure is greater than that at constant volume the latter being regarded as the true specific heat. The ratio of the two plays an important part in the behaviour of a gas when suddenly compressed and rarefied. If we suddenly compress a gas we find that its temperature rises and until the heat thus developed is dissipated the pressure of the gas will be greater than that given by the simple gas law. Now in a great many practical cases this expansion and contraction of the gas without transference of heat to or from it is of the highest importance obviously the commonest case will be that in which the expansion or compression takes place so suddenly that there is no time for the gas to take in heat from or give it out to the walls of the vessel in which it is confined. This is the case with ordinary air compressors. The air is compressed suddenly and it is greatly heated thereby hence the necessity for cooling the cylinders of such machines. We speak of *adiabatic* compression or rarefaction when the gas is not allowed to gain or lose heat in the process and of *isothermal* compression or rarefaction when the temperature is maintained

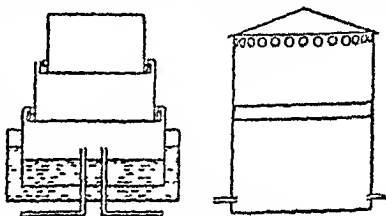
constant An important case of adiabatic conditions occurs in *sound* ($q v$), which consists of waves of very rapid compression and rarefaction in the air. In engines of all kinds, working by the expansion of gases and vapours, the conditions in the cylinder are practically adiabatic, in the internal-combustion engine, the rapid compression of the air drawn into the cylinder for the purpose of burning the fuel causes a great rise in its temperature, in the Diesel engine this temperature is sufficient to cause ignition when oil is injected into the cylinder at the end of the compression stroke.

We have said that if a gas is allowed to expand through a fine orifice, its temperature is only slightly changed, that of a perfect gas would not be changed at all. But if a gas is allowed to drive an engine by its expansion, we find that it cools down very greatly. These facts sometimes appear confusing. They are easily reconciled by imagining the gas driving a turbine. Here the gas streams out of a nozzle as a jet, and then possesses two kinds of energy, firstly, the heat contained in it by virtue of its temperature, and secondly, the kinetic energy due to its motion. The latter must obviously be accounted for by a fall in temperature of the gas, some of its internal heat has been used up to give it kinetic energy. If this kinetic energy is converted into mechanical work by acting on the turbine blades, the gas remains cooled, but if the kinetic energy is allowed to dissipate itself in friction, as happens when the gas rushes out of a fine orifice into a large space, it suffices exactly to warm the gas back to its original temperature (see THERMODYNAMICS).

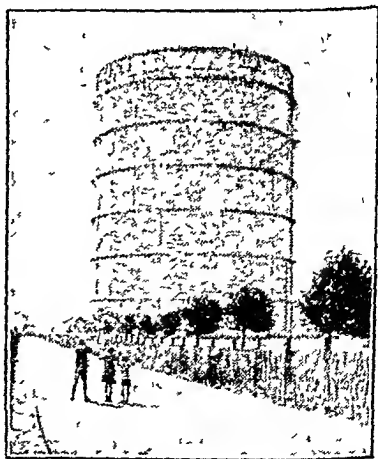
Gases, like liquids, possess internal friction or viscosity ($q v$). This internal friction is possessed by a theoretically perfect gas, and hence the latter is not, as is sometimes supposed, a perfect fluid. A rather paradoxical result of the theory of gases, and one confirmed by experiment, is that the

viscosity of a perfect gas is independent of its pressure. The conductivity for heat of gases is also independent of the pressure. It is extremely small, and hence the best heat insulators consist of very porous substances, which prevent the transference of heat by convection of the gas, which then forms the main body of the insulator. What has been said concerning viscosity and conductivity does not hold for gases at very low pressures, hence in the *Dewar flask* ($q v$) although the vacuum between the walls is not perfect, the conduction of heat by the residual gas is very much reduced.

Gas-holder, apparatus for storing gases Hydrogen, oxygen, carbon dioxide, chlorine, and other technical



Sectional Diagram of Gas holder



Gas holder, Southall

gases are stored under pressure in steel cylinders. Vehicles now on the roads are driven by illuminating gas compressed to a pressure of c 300 atmospheres (see INTERNAL COMBUSTION ENGINES). The storage of large quantities of low pressure gas is by a *gasometer* which comprises an inverted cylindrical bell resting on a tank of water and sliding between guides. Large gas-holders are frequently telescopic so that the depth of the water tank can be diminished in proportion to the number of sections or lifts employed. The inside lift is a shallow bell with a domed top; the other lifts being cylinders open at both ends provided at the top with an overhanging rim and at the bottom with a water channel. The inner bell rises first and finally the overhanging rim of the next lift enters the channel round its bottom. This seals the joint with water (the pressure of the gas being very low) and the bell and first lift then rise until they pick up the second lift and so on.

Large dry gas holders consist of vertical cylinders of sheet metal containing a piston pushed up as the gas collects below. The joint between the cylinder and piston is sealed either by rubber rings or by flooding with gas tar.

Gaskell, Mrs. Elizabeth Cleghorn (1810-1865). English novelist. Her early novel, *Mary Barton* (1848) brought her to the notice of Dickens in whose *Household Words* her best story, *Cranford* (1853) appeared serially. She wrote also a *Life of Charlotte Brontë* (1857). *Cranford* has become a classic and is by some considered equal to Jane Austen's work, with which, indeed it has much in common.

Gas Manufacture. The discovery of coal gas described to the Royal Society in 1739 by John Clayton and practised on a wide scale by William Murdock in 1793 has influenced industrial development tremendously. The Gas Light & Coke Company was incorporated in 1812 and Westminster

Bridge was lighted by gas in 1813. Coal gas is given off by bituminous coal when heated in absence of air; the products vary considerably with the temperature to which the coal is heated. The carbonisation of coal is now carried on at three different temperatures. The highest over 1000 C produces metallurgical coke for use in blast furnaces (see IRON AND STEEL); this gas known as coke-oven gas is of good quality. In making town gas the temperature is lower c 500-900 C. The much-discussed modern process of low temperature carbonisation employs temperatures in the neighbourhood of 600 C. The gas produced varies in composition according to the temperature being richer in hydrocarbons at the lower temperatures (see also COKE).

Town gas manufacture is carried out to-day by two methods one of which the horizontal fire-clay retort has been in use for nearly a century but is now rapidly being superseded by the vertical retort which allows of continuous working. In modern large works the horizontal retorts are 20 ft. long 20 in wide and 13 in high, having a flat bottom, a semi-circular top and being open at both ends. After filling with coal cast iron mouth pieces are bolted to the ends and made gas-tight with fire-clay iron filings and sal ammoniac. A number of retorts (5-12) are set in a furnace tunnel. The vertical retort, originally proposed in 1858 was actually worked in a continuous form in 190* and in 1903 Woodall and Duckham developed the vertical retort succeeding in feeding the coal continuously into the top of a vertical tubular retort a number of which are placed in a furnace tower heated by producer gas. The coke is discharged into water at the bottom of the retort the steam thus generated passing upwards through the retort and being converted into water gas.

Illuminating gas was originally burned in plain batwing burners the light it gave in such a burner was the test of its utility. Nowadays it is

burned for lighting as a non-luminous flame which heats a gas-mantle. Its use domestically and industrially as a source of heat is becoming relatively more important as electricity displaces it for illumination. Hence the legal standard for the sale of gas has now been fixed with reference to its heating value, the unit being the *Therm*, or 100 000 British Thermal Units. (The B.T.U. is the heat required to raise the temperature of 1 lb. of water by 1°F.)

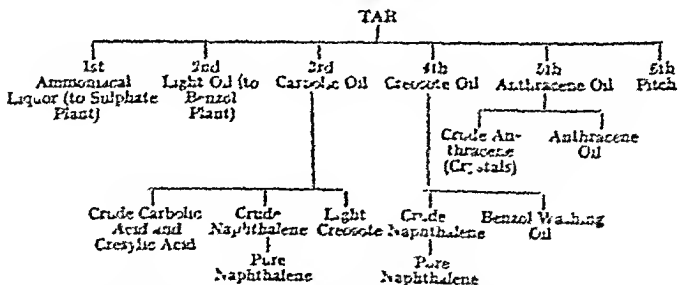
The purification of the gas from retorts is of the highest importance, since the sulphur of the impure gas becomes sulphuric acid when burned, this being responsible for most of the deleterious effects of the air of large towns. Metal fittings and the colours of paper and fabrics suffer severely in rooms in which gas is burned.

The gas passes from the retorts through a water seal in a "hydraulic main," where tar and water condense; it then passes to a scrubber, a tall, vertical tower, where it is brought into contact with a large surface of water trickling down over a filling of coke, wooden boards, or bricks. Many types of scrubbers have also spraying devices worked by centrifugal force, or other

removed by passing the gas through a purifier, where it is brought into contact with oxide of iron, which is converted into sulphide of iron. Sulphuretted hydrogen (H_2S), in which form nearly all the sulphur is present in the gas. The remainder is present as carbon disulphide (CS_2), which is not thus removed. The main constituent of the watery liquor is ammonia, a substance of value as fertiliser. It is recovered by distilling with milk of lime, whereby it is liberated as gas, and absorbed in sulphuric acid, forming sulphate of ammonia, which is readily saleable.

The direct process of making ammonium sulphate necessitates the complete removal of the tar from the gas coming from the retort, this being effected by a centrifugal separator. The gas is then brought into contact with sulphuric acid, whereby crystals of sulphate of ammonia are formed.

The treatment of the tar, the most important by-product, is carried out by fractional distillation (see CHEMICAL ENGINEERING). The composition differs greatly according to the type of carbonisation, more of it, and of more valuable composition, is produced by low-temperature carbonisation than

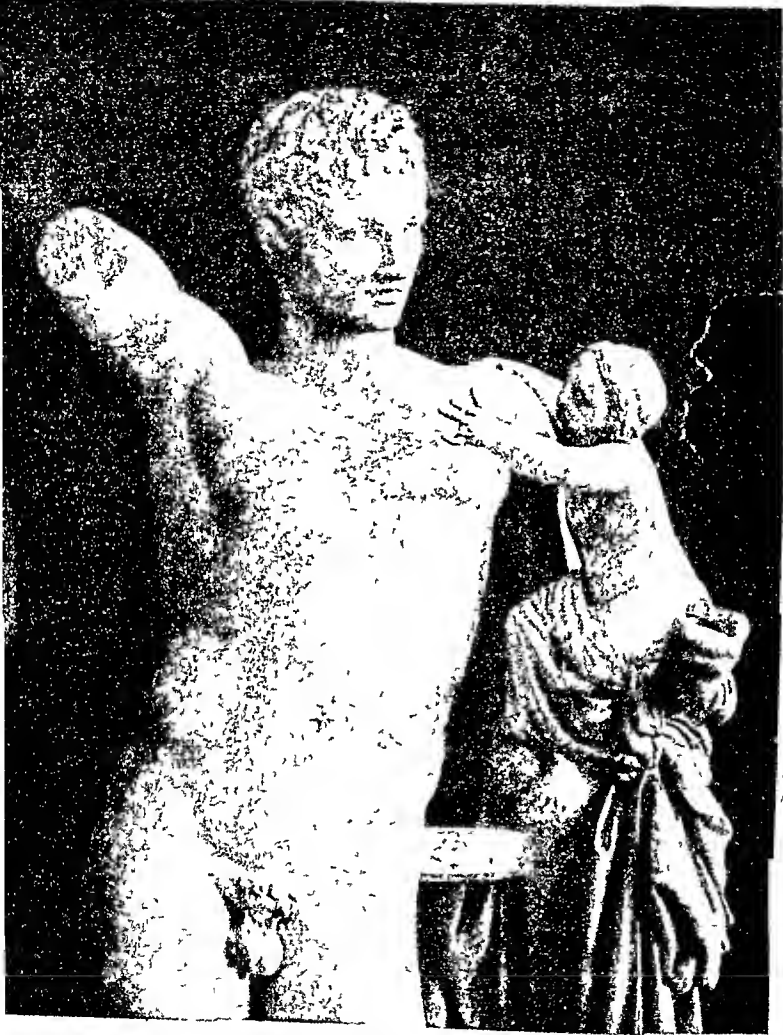


arrangements for producing a large surface of contact between gas and water. The tar and liquor from the scrubbers contain together a mass of valuable by-products, without which the sale of gas at its present price would be impossible. Sulphur is

by high. The tar is present in the gas in a very fine state of division, and it is difficult to precipitate the last of the mist or fog. The constituents recovered from it by fractional and repeated distillation are given in the table above (Armstrong).



GREEK SCULPTURE THE DISCOBOL OF MYKON
(H. A. V. 100)



GREEK SCULPTURE THE HERMES OF PRAXITELES

Low-temperature carbonisation has long been known to be advantageous on account of the value of the products obtained but technical difficulties have been overcome only recently. The difficulty is to discharge the retorts after carbonisation when a continuous process is used for even with dis-continuous working the difficulties are great. Low temperature coke is now easily obtainable and forms an excellent domestic fuel for the open grate while the economics of its production are of course decided by the revenue from the tar distillation product. According to the Low Temperature Carbonisation Company the makers of coalite a ton of averag coal yields 14 cwt of coalite 3 gallons of motor spirit 20 gallons of oil, 15 lb of sulphate of ammonia and 3-5000 cu ft. of rich gas. An important point is the alternative process of hydrogenation (*qv*) whereby the coal is heated under pressure with hydrogen and a much larger yield of oils and spirits obtained.

Water gas is produced by the action of steam on glowing carbon or coke the reaction absorbs heat and therefore does not continue of its life. The method employed is to form a bed of highly heated coke by blowing air into a fire-brick lined steel casing containing the coke and then shut off the air and admit the steam. Water gas is now a source of hydrogen for hydrogenation (*qv*) and also in the synthesis of methyl alcohol (*see* CATALYSTS INDUSTRIAL APPLICATIONS OF).

Producer gas is obtained by the action of a suitable supply of air upon a bed of glowing coke. The lower layers of carbon which the air first encounters burn to carbon dioxide (CO_2) which is reduced to carbon monoxide by contact with the upper layers of glowing carbon. The result is a mixture of carbon monoxide and nitrogen generally contaminated with a considerable percentage of carbon dioxide. Steam is frequently added but though this enriches the gas by the producti r gas it tends

also to cause an increase in the carbon dioxide.

Suction gas is producer gas derived from producers through which the air is sucked by the suction stroke of a gas engine. Great efforts have been made to develop this system for use on heavy vehicles especially in France where wood charcoal is plentiful in many districts. *See also* COAL FUEL INTERNAL COMBUSTION ENGINES.

See John Armstrong *Carbonisation Technology and Engineering*, (London 1929).

Gas Masks see CHEMICAL WARFARE

Gas Meters see METERS

Gas Oil, a liquid petroleum distillate with a viscosity somewhat below that of lubricating oils. It is therefore used not for lubrication but in the manufacture of coal gas (*qv*) for carburetting the gas the oil is vaporized and the vapours incorporated with the gas which increases the calorific value and illuminating power of the latter. Gas oil is also used as the charging stock in cracking plants where it is broken down with the formation of lighter fractions suitable for use as motor spirit.

Gasoline, the American (USA) term for the light petroleum fraction used as a fuel for high speed internal combustion engines better known in England as motor spirit or petrol (*qv*).

Gas Pipette, see GAS ANALYSIS

Gasquet, Francis Aidan (1846-1929) English historian and Roman Catholic ecclesiastic. He became Superior of the Benedictine Monastery at Downside (1888-84) and was created Cardinal in 1914. He earned his reputation for his books on the medieval English Church and on the monasteries and their relation to the Reformation. In 1918 he became prefect of the Vatican Archives and subsequently President of the Commission for the revision of the Vulgate (*qv*).

Gastein, Convention of (1865) between Austria and Prussia at the close of the Schleswig Holstein War. By 1

Schleswig was ceded to Prussia and Holstein to Austria

Gaster, Moses (b 1856), Jew of Rumanian birth, Haham or Chief Rabbi of the Sephardic communities in England. He entered England, 1886, on his expulsion from Rumania for his devotion to the cause of the oppressed Jews. He held a lectureship in Slavonic and Byzantine literature at Oxford, 1886 and 1891.

Gas Thermometer, *see* TEMPERATURE, MEASUREMENT OF

Gastritis, inflammation of the mucous membrane lining the stomach. *Acute gastritis*, usually caused by eating indigestible food, is frequent in children, gouty persons, and those addicted to alcohol. The symptoms are pain and distension in the stomach, headache, nausea, and vomiting, followed often by a coated tongue and diarrhoea. The attack is short, often lasting only a day. The best treatment is to take a purgative, and to fast until the attack diminishes, when a milk diet should be taken at first. *Chronic gastritis* may be caused by indigestible food taken over long periods of time, extreme indulgence in alcohol, tea, or coffee, bolting of meals which are not sufficiently masticated, or may be due to such diseases as cancer, ulcers of the stomach, tuberculosis, or anæmia. The symptoms are similar to those of acute gastritis but more persistent, and may lead to emaciation. It should be treated by dieting, eliminating alcohol and tea, and not drinking with meals, which should be eaten in a leisurely manner.

Gastropoda, a class of the Mollusca, which includes the snails and slugs, no doubt descended from a form like *Chiton* (q.v.), which they resemble in the structure of the head and foot, but from which they are distinguished by the disappearance of the bilaterally symmetrical arrangement of the alimentary, circulatory, and respiratory organs, which are twisted round to the right, and by the presence of only a single shell, which is typically spirally coiled.

According to the degree of twist of the internal organs, contained what is called the visceral hump, the Gastropoda are divided into two main groups, the *Euthyneura* and the *Streptoneura*. In the *Euthyneura*, a straight-nerved group, the nervous system is affected to a comparative slight extent by the twisting, and in the species are hermaphrodite. In this group belong the typical air-breathing snails and slugs which have the eyes at the tips of the first pair of "horns," and the cavity of the mantle modified as a lung, with a small orifice. The group also includes some common freshwater snails, which have the eyes at the bottom of the "horns," and a similar lung adapted for water-breathing, and a number of marine species, some like typical gastropods breathing by gills, and others, called from their shape sea slugs (q.v.), which breathe by means of special dorsal processes and have no shell. There are also some aberrant swimming species, formerly called pteropods (q.v.), because the foot is modified to form a pair of wing-like flaps.

The second group, or *Streptoneura*, shows the maximum modification of the visceral hump, the nerve cord being twisted in a figure of 8. The sexes are distinct. To this group belong most of the ordinary marine creeping, large-shelled gastropods, like the limpet, the periwinkle, the cowrie, and the whelk. It also contains some very aberrant free-swimming species, which are translucent and have the shell small, or absent, and the foot flattened from side to side like a kind of fin.

Gastropods are now probably just past their acme as a successful group. They have been in existence since the Cambrian, and nearly all the families in existence at that time are still represented to-day. Fossil gastropods are very abundant in early Tertiary beds.

Gateshead, seaport in Co. Durham, on the S. bank of the Tyne, opposite Newcastle. It is an important ship-building centre, and has extensive iron and engineering works. Glass au-

chemicals are manufactured here Since the fire of 1854 which destroyed most of the town Gateshead has been largely rebuilt Pop (1931) 12, 380

Gathering *see* NEEDLEWORK

Gatling Richard Jordan (1818-1903)

American inventor of the machine gun which bears his name After numerous inventions in agriculture including a sowing machine and steam plough he patented his gun in 1861 The latter which consisted of 8 or 10 rifle-barrels could maintain a constant fire when worked by a revolving handle

Gatling Gun, *see* GUN

Gauchos, natives of Uruguay and the Argentine pampas mostly of Spanish American origin They are chiefly nomad cattlemen daring horsemen expert at using the bola and lasso They are hospitable but with poor social customs

Gaugamela, *see* ARBELA

Gauguin, Paul (1848-1903) French painter born in Paris and educated in Orleans and Peru In 1871 he entered a banking firm in Paris It was not until 1875 when he was 27 that he began to paint six years later he had left his wife and family and thrown up his career In 1887 he went to Martinique where he stayed for some time painting before returning to settle at Pont Aven in Brittany

Gauguin whose strongly drawn and coloured paintings were highly individual to himself was seized upon as the founder of the new school of synthesisism Gauguin himself was not very interested he went to Arles to join Van Gogh but the latter's attacks of insanity made it impossible to work with him and he returned to Paris Despairing however of earning a livelihood by art and drawn towards places remote from the affectations and pretensions of Paris he sold all his work in 1891 and migrated to Tahiti With the exception of one visit to Paris in 1895 the rest of his life was spent living with the natives as one of themselves winning their confidence and affection and painting scenes from His book

Noa-Noa gives a fine account of his experiences For the last 3 years of his life he lived at Domuha in the Marquesas Islands

Although a number of fine landscapes and portraits and figure subjects were painted in France including *Le Christ jaune* it is in his South Sea Island paintings that Gauguin is seen at his best Simplicity of drawing and modelling without sacrifice of solidity magnificent richness of colouring and exceptional beauty of design—all these qualities were devoted by



Paul Gauguin The Road

Gauguin to expressing his intense admiration and sympathy for the natives and his own emotions and ideas about life

Gauguin is now accepted as one of the greatest painters of modern times and has had a host of imitators His Tahitian work set the fashion for the return to the primitive

Gaul, part of W Europe divided by the Romans into Cisalpine Gaul (*see* Gaul on this side of the Alps, viewed from Rome) comprising the district of N Italy and Transalpine Gaul (Gaul beyond the Alps) comprising modern France Belgium, and Switzer

and, with parts of Germany and Holland. Its history begins c 600 B.C. After the extinction of the Empire of the West in A.D. 476 most of Gaul passed to the Franks, after whom it was called France.

Gault (*Golt* or *Galt*), a thick blue or grey clay formation, variously considered as belonging to the Lower or Upper Cretaceous system (*qv*), and found typically in S.E. England, where locally it passes up into the Upper Greensand. In Dorset the same transition is seen, but there it is lateral, suggesting that the clay and sand are contemporaneous. To the N. it is replaced by the Red Chalk of Norfolk, Lines, and Yorks. The greatest thickness of the gault is c 300 ft. It is well exposed at Folkestone, and a good fossiliferous exposure near London is at Duntun Green, near Sevenoaks. The gault passes under London and by forming an impervious layer under the chalk, helps to preserve the water in that formation, and thus contributes to the water supply. See also ARTESIAN WELLS.

Gaultheria Oil, alternative name for the essential oil obtained from the shrub *Gaultheria procumbens*, more often known as wintergreen oil (*qv*).

Gaunt, John of, see LANCASTER, JOHN OF GAUNT, DUKE OF.

Gaur, a huge wild bull, brown in colour, but with white legs, known in India as the bison and in Malaya as the seladang.

Gautama, see BUDDHA.

Gautier, Théophile (1811-1872), French author, who early gained wide fame with lyrics in imitation of Ronsard, Du Bellay, and other members of the *Pléiade*. His poetry is notable for its perfect style and form, and for richness of imagination. It includes *Albertus* (1830), *Comédie de la Mort* (1832), and *Emma et Camées* (1856 and 1872). His best stories were *La Mort Amoureuse*, *Le Capitaine Fracasse*, and *Mademoiselle de Maupin*. His remaining works are those of a journalist critic, they all display the characteristic perfection of style and

delicate humour that made Gautier one of the most important French writers of the 19th century.

Gauze, a fabric composed of "stationary" straight threads, woven with open texture, and "crossing" threads in various zigzag directions.

Gavelland, see TENURE.

Gaveston, Piers (*d* 1312), foster-brother of Edward II of England, son of a Gascon knight. He obtained great influence with the prince, but his insolence offended the barons, and he was banished by Edward I. In 1307, when Edward II became King, he was recalled and created Earl of Cornwall, and in the following year was Regent during Edward's absence in France. He was banished again, but returned to England in 1311. He was seized, and beheaded.

Gawain [GAH'WÂN], Sir, one of the bravest of King Arthur's Knights of the Round Table. His fight with the Green Knight is well known in mediæval romance. He died fighting against Modred.

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Gayal (or *Mithan*), a species of ox related to the gaur (*qv*) and domesticated in N.E. India.

Gay-Lussac, Joseph Louis (1778-1850), French chemist. His earliest researches were in the realm of the physical properties of gases. In 1802 he stated "Gay-Lussac's Law" of expansion of gases, i.e. "At constant pressure, the volume, V, of a given mass of any gas is proportional to its absolute temperature." (See GASES, PHYSICAL PROPERTIES OF.)

In 1804 the French Academy organised some experiments on magnetism

to be condu ted from a balloon and Gay Lussac ascended with J B DuRoi. A month later he ascended again alone to almost twice the previous altitude (7000 metres) and made observations on the condition of air at that height. In 1808 he isolated metallic potassium and later produced boron from boric acid.

Gaza, town and port of strategic value S of Jaffa Pale tine. Its only manufacture is a coarse kind of cloth it is also a grain-distributing centre. It was the scene of Samson's feat with the gates and of his triumphant death. Under Hadrian fairs were held here for the sale of Jewish captives. Napoleon took it in 1799 and Allenby in 1917. Pop 17,000 decreasing owing to the tendency of the Arabs to move into the Jewish settlements where employment is obtainable.

Gazelles form a group of gregarious antelopes (q.v.) represented by a large number of species found in more or less desert districts in Central and S Asia and N Africa. The horns usually

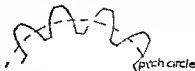


Gazelle

present in both sexes are seldom long but are lightly curved and bear stout ridges in front. The colour is typically sandy brown relieved by a black band on each side of the face and flank. Gazelles are gracefully built with long slender limbs and are remarkably swift footed.

Gearing strictly the means by which motion is transmitted by direct contact from one rotating part to another but frequently extended to cover other means such as belts chains and hydraulic pumps which transmit power from one part of a machine to another. Gearing may be either by

friction used only when the amount of power to be transmitted is small or when the gear ratio is required to be



Spur & ang. th. & h. & r. & d. & c. & b. positions with the & best thrust is exerted

continuously variable or by teeth. The gear ratio is the ratio of revolutions made by one shaft to those made by the other in the same time. Correctly shaped teeth of gear wheels produce an even drive with minimum wear. Contact between the teeth is then only along a line of length equal to the width of the teeth hence each tooth must be strong enough to carry the whole load. Three types *epicycloidal* *cylindrical* and *involute* all satisfy these conditions but involute teeth formed in a continuous curve from root to point are best and are displacing other forms. In gears with teeth parallel to the axis of rotation there is a slight variation in the motion of the two wheels relatively to one another avoided by *helical gears* in which the teeth are cut at an angle. As many teeth as possible should be



Double Helical Gearing

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female the male being the gander and the young the gosling Geese are found almost all over the world About 10 species occur in Great Britain mostly as winter visitors the only resident species being the grey lag goose so called because it stays or lags behind in the spring when the winter visitors go N to breed This goose very widely distributed in the N parts of the E hemisphere is the species from which the W breeds of domesticated geese were derived several thousand years ago Domesticated geese differ little from the wild type except that they are larger and usually white instead of greyish brown In the East another species the Chinese goose has been domesticated It is a larger bird has a more upright carriage and the gander has a black swelling where the beak passes into the forehead It is not infrequently kept in England and forms fertile hybrids with English geese

Geese Rearing The demand for geese is limited and variable and the special Michaelmas market has almost ceased but they are still as profitable as any other class of poultry in comparatively small flocks where there is plenty of rough grazing The objections that four legged stock will not graze after geese and that they destroy the herbage of the pasture do not appear to be well founded though the ground should be allowed to freshen for a few days after them Geese do crop grass very closely but they search for and greedily devour buttercup roots which should recommend them to dairy farmers

Breeds The *Emden* weighs c 18 lb but can be fattened considerably beyond this It is a white bird with tall upstanding carriage

The *Toulouse* is a heavier bird and dark grey on the upper part merging into white beneath

Breeding Geese begin to lay in Feb and produce 30 to 60 eggs in a season if not permitted to sit They lay till an advanced age and the eggs of mature birds are much more reliable

than those of young stock the eggs are less frequently infertile and the goslings more hardy and vigorous A hen will cover 4 goose eggs and a goose 10 Incubation lasts 30 days or even longer sometimes the goslings require a little assistance to emerge from the shell They should be fed first when 24 hours old on meal in separated milk They should be able to find practically all their food when 6-8 weeks old

Fattening of birds requires some 4 weeks and they should then have one feed of grain daily and a second of muller's offals barley meal maize and gluten meals and boiled potatoes or swedes

Gehenna, Bible name for Hell after Ge Hinnom valley of Hinnom a valley to the W of Jerusalem used for the burning of city refuse and as a dumping ground for dead animals etc

Geiger Conrard see **ATOM**

Geikie Sir Archibald (1835-1914) distinguished British geologist Professor of Geology and Mineralogy in Edinburgh University and later Director General of the Geological Survey of the United Kingdom He was the author of many works upon this branch of natural science including a valuable textbook but is justly famous for his unrivalled ability to write elementary volumes on the subject using the simplest language and explaining its difficulties in a manner both interesting and intelligible to the young He was created KCB in 1907 and received the OM in 1914

Geisha, in Japan a professional entertainer of the female sex These girls undergo a long training in singing the art of conversation playing various musical instruments and etiquette They usually contract with tea houses It is considered honourable in Japan for a girl to take up this profession to assist her parents and though it is frequently combined with prostitution it does not prejudice her chance of marriage at a later date

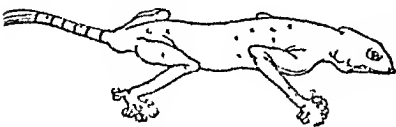
Geussler Heinrich (1814-1899) was born at Ingelschieb Saxe-Meiningen

stepped wheels, a number of identical wheels side by side, the teeth of each being a little behind the preceding wheel. A helical gear is equivalent to this, but with it a pressure is exerted towards the axis. This is avoided by *double helical gearing*, two sets of helical gears sloping opposite ways. The average leverage exerted by the force on the teeth is less than in ordinary gearing, hence helical teeth are stronger than ordinary ones of the same material.

Bevel wheels transmit power from axes which are not parallel but intersect, they can be designed to operate as efficiently as a spur wheel, and are much used in machine design. An important instance is the differential of a motor-car, which uses epicyclic gearing (*qv*). A worm wheel is threaded similarly to a screw. Its great advantage lies in the very large gear ratio obtainable.

Gear wheels are not necessarily circular. By using a number of wheels of other shapes, the gear ratio between two shafts may be varied from point to point in their revolution. An important application of such gearing is that of imparting a *quick return motion* (*qv*). See also TRANSMISSION OF POWER.

Geckos, a family of medium-sized lizards which owe their name to the sound emitted by a common European species. They are found in warm countries all over the world, inhabiting forests, deserts, and houses. The house



Gecko

species is the best known, especially in India, where they appear soon after sunset and climb about the rooms in search of insects, the suckers on their feet enabling them to adhere to the ceilings when upside down. Though

perfectly harmless, and even useful reptiles, they are regarded with superstitious hatred by the peasants of the Mediterranean countries, who believe that they poison or contaminate everything they touch.

Geddes, Sir Auckland (b 1879), British politician, born at Edinburgh. He was a physician, but is best known for his work in the World War as Director of Recruiting (1916) and Minister of National Service (1917). He was appointed President of the Board of Trade in 1919. For 3 years, from 1920, he was British Ambassador in Washington. He is the brother of Sir Eric Geddes.

Geddes, Sir Eric Campbell (b 1875), British business man who became prominent during the World War. His experience of railway management in England, S America, and India led to his appointment in 1916 as Director-General of Transport, in charge of the railway organisation in France. In 1917 he went to the Admiralty, first as Controller of Shipping and later as First Lord. He became first Minister of Transport in 1919. As chairman of a public economies committee he wielded the "Geddes Axe" from 1921 to 1922, subsequently retiring from Parliament to become chairman of Dunlop Rubber Co and of Imperial Airways Ltd.

Geelong, city and seaport, Victoria, Australia, is situated on Corio Bay, c 45 m by rail from Melbourne. It is an important wool centre, and a considerable amount of cloth is woven in the district. There are also flour-mills and tanneries. Geelong was formally claimed as a possession of the English Crown by John Bateman in 1835. It owes its present importance to the gold discoveries of 1851. Pop (1931) 42,700.

Geese, name for numerous species of the duck family, intermediate in size and length of neck between swans and ducks, and less aquatic in diet and mode of life than either, walking on land to graze, for which their beaks are adapted. Goose is the name for the

Aquamarine a pale blue stone popular in pendant form. Brazil and the Ural Mountains are its principal sources.

Jeryl green crystal related to the aquamarine.

Carnelian a beautifully warm red stone of which many fine necklaces are composed. Its principal source is the Orient but it is also found in Great Britain.

Diamond The hardest of all precious stones the diamond (*q1*) is a carbon deposit usually in crystal form. Its great refractive power makes it the most brilliant of all gems though in its original uncut form it is dull in appearance. Diamond-cutting is an art which dates back to the 15th cent but was not developed to any great extent before the middle of the 18th. The earliest diamonds were found in India in the early 18th cent they began to be mined in Brazil and in the middle of the 19th cent the first diamond was found in S Africa which is now the greatest diamond producing country in the world. It was a S African mine that yielded the largest diamond the *Cullinan* an enormous stone presented to King Edward VII by the Transvaal Government in 1907. The famous Koh-i-nor diamond is of Indian origin and was presented to Queen Victoria by the E India Company in 1850. The Hope diamond was blue in colour.

Emerald a variety of beryl bright green in colour. It is a very ancient stone being valued in Egypt in Cleopatra's time. In later times it has been found in S America Siberia and New S Wales. It was once believed to have medicinal qualities.

Garnet a stone found in fairly large quantities in many countries including Brazil Burma Saxony and Bohemia. It is usually dark red but is sometimes found in other colours.

Jade an Asiatic stone usually found in shades ranging from white to dark green used as a material for carvings of various kinds especially by the Chinese.

Lapis lazuli one of the most ancient of stones blue in colour found in Persia Afghanistan and China.

Onyx a stone coloured in stripes or layers black and white being a common combination. It was one of the chief and earliest stones from which cameos (*q2*) were cut and is obtained in India Arabia and Scotland.

Opal a stone giving a beautiful liquid colour effect which changes in accordance with the movement of the stone. The fire opal seems to have a living flame imprisoned in the lucid depths but has for long had a reputation for duck. Queensland Mexico and New S Wales are the principal opal producing countries.

Pearl the smooth and shining secretion in the shell of certain oysters deposited in layers round a foreign body that has become embedded in the tissues of the mollusc. The more or less spherical object which is the form taken by this succession of layers has been eagerly sought for centuries in many parts of the world—in the South Seas off various parts of Australia Ceylon and Lower California. The lochs and rivers of Scotland have for long yielded pearls and they were found in Britain at the time of the Romans. An important industry has sprung from the discovery that pearls called culture pearls can be artificially produced by inserting foreign bodies into the oyster.

Ruby the most precious of precious stones. There are two main varieties the *Oriental* and the *Spinel* of which the first is the more valuable. Burma is the chief ruby producing country but they are also to be found in Siam and Ceylon. The finest ruby in this country is that which is set in the Imperial State crown an enormous stone known as the Black Prince's ruby and worn by Henry V at the Battle of Agincourt.

Sapphire a stone whose colour ranges from pale to very deep blue. It is found in many parts of the world chiefly in Siam Burma India Ceylon Australia and in the United States.

He was a glass-blower by trade, and became famous for the chemical apparatus manufactured by him

Geissler Tube, an apparatus used in studying electrical discharges through gases, consisting of a partially evacuated glass tube fitted with platinum electrodes. *See also CONDUCTION OF ELECTRICITY THROUGH GASES*

Gel, *see COLLOID CHEMISTRY*

Gelada, a somewhat baboon-like monkey with a cloak of long hair on its shoulders, found in the mountains of Abyssinia

Gelatine (or *glutin*), a compound of animal origin obtained by the hydrolysis of an albuminoid protein, collagen, found in the bones, cartilages, and connective tissues of animals. Gelatine is obtained in very large quantities by the digestion of bones with hot water, slightly acidified with hydrochloric acid, the bones having been first degreased. The extraction of the gelatine is carried out in two or more stages, that from the earlier extractions being the purest. The liquors are then clarified with alum or another clarifying agent, and run into vacuum evaporating pans, where they are concentrated. On cooling they set to a solid mass of gelatine, in the "dry" state it contains over 15 per cent of water and, if placed in water, swells considerably with absorption of the liquid, it dissolves if heated. Solutions of gelatine containing even as little as 1 per cent of the material have the property of setting to a solid jelly on cooling.

Edible gelatine is used in the manufacture of numerous foodstuffs, such as soups and jellies. It is also employed in the manufacture of capsules containing various unpleasant-tasting medicines, so that these may be comfortably swallowed. Gelatine is easily digestible, and has a moderate calorific value, but is by itself insufficient as a source of protein, since certain amino-acids which are necessary for adequate nutrition are absent from it.

Photographic gelatine is employed in the manufacture of films and print-

ing papers, while the technical grade used for a variety of purposes, such as an adhesive, size, and as a colloid protector in a number of processes such as electro-plating.

A form of gelatine obtained from fish residues is known as isinglass. **ADHESIVES** The water-soluble portion of silk, which is a protein called sericin, is also sometimes known as silk gelatin.

Agar-agar (*g v*) is also sometimes known in commerce as Bengal, Ceylon Chinese, or Japanese gelatine.

also BONE PRODUCTS

Gelatine Dynamite, *see EXPLOSIVES*

Gelderland, fertile flat province, Holland, S of the Zuider Zee, watered by the Maas, Waal, and Rhine. Tobacco, flax, and cereals are grown in the district surrounding Arnhem, the capital, the manufactures being paper and cotton. Area, 1941 sq. m. pop. (1931) 843,230.

Gelert [*GEL'ERT*], Welsh legend of a hound, which saved the child Llewellyn from a gigantic wolf. His master saw the dog covered with blood and killed it, assuming that it had killed his child, but entering his home he discovered the child alive and the body of the wolf beside it. The dog was buried at Beddgelert in Wales, where its grave is pointed out to travellers. Variants of the legend are known in many countries.

Gelignite, a blasting explosive chiefly composed of nitro-glycerine and potassium nitrate. *See also EXPLOSIVES*

Gem, strictly, a precious stone that has been cut and polished, but in its wider meaning the term is applied generally to pearls and to those precious and semi-precious stones whose beauty and rarity cause them to be sought after as personal adornments.

Agate An extremely hard stone found in great variety of colour, the finer types, known as moss agates, being particularly striking. In Scotland agates are to be found in Angus, Kincardineshire, and in the S.W. Brazil, however, is richest in this type of stone.

Amethyst, a quartz found in Brazil, Australia, and Siberia.

the explanation of the facts of genetics (qv) and heredity (qv)

Genesis the first book of the Old Testament so called from the opening words. In the beginning. The first few chapters give the stories of the Creation the Fall of Man and the Flood. The following chapters give an account of the ancestors and patriarchs of the Israelites until their migration to Egypt under pressure of famine. The book cannot be considered historical though when linked with other (archaeological) evidence it casts some light on the history of the Hebrew people.

Genet. a small elegant carnivorous mammal related to the civets (qz) and found in Africa and S. Europe.

Genetics, the study of the origin of individuals and of the similarities and dissimilarities of organisms related by descent.

Genetics consequently involves a study of heredity (qv) and resembles this science in its endeavour to find an explanation of the phenomena of variation and inherited resemblances in the structure and behaviour of the germ cells and the subsequent divisions of the egg. Genetics thus depends on cytology (qv) and embryology (qv) and one of its problems is the explanation of the attainment of any characteristic adult form as a result of the potentialities of the egg. Genetics thus links cytology and embryology with experimental morphology (qv) a field in which much work remains to be done. The oldest sources of information in the study of genetics are those of observation and experimental breeding. While ignorant of scientific knowledge of heredity and even of the process of fertilisation in plants very early in agricultural history man attempted to improve his crops by selecting the finest fruits and sowing their seed. Although this method yielded mixed results by continued selection on the crops became improved sufficiently to distinguish them from their wild ancestors and selection as a result of observation is still used as a

method of improving crops. Similarly in breeding animals man selected for mating animals possessing the characteristics he wished to propagate. Gregor Mendel (qv) was the first investigator to establish breeding on a scientific quantitative basis and the definite laws he formulated were subsequently verified mathematically.

These laws have become much more intelligible since cytologists have examined the germ cells of plants and animals under genetic investigation and have found in the cell (qv) and particularly in the chromosomes of the nucleus probable material bases for the transmission of characteristics. Each chromosome is supposed to be composed of units called genes (qt) each of which either alone or perhaps more usually in association with other units is responsible for the development of a definite characteristic. This theory of the gene was postulated by Prof. T. H. Morgan as a result of his work in breeding the vinegar fly and other organisms. Every characteristic of the parent must be represented by one or more genes in the oöum and also in the spermatozoon. Consequently after fertilisation two sets of genes are present in the egg. If one has a stronger potentiality than the other a dominant characteristic results. For example the children of one parent with pure brown eyes and one with blue eyes are always brown-eyed but since their cells contain a gene from each parent the eyes of the children are impure brown. Brown is the dominant and blue the recessive colour. If both parents have impure brown eyes when the reducing division of the nucleus takes place in the formation of the germ cells the paired characteristics are separated and go into different cells. Thus one germ cell will contain the gene for the brown colour factor and the other that for the blue one and each parent will have equal numbers of germ cells with each colour factor. Consequently in fertilisation the possibilities are

(1) Germ cells with the brown colour

Topaz, stone found in crystal or pebble form in Brazil, Siberia, the Ural Mountains, and the British Isles. Its colouring varies, yellow being one of the commonest tints, but the topaz may be red, green, blue, or colourless.

Turquoise, an opaque mineral, in colour blue ranging to green, found principally in Persia. The stone is often set elliptically in rings, with a convex surface, and is also used for necklaces. Its colour is apt to be affected by exposure to light, and in old stones the original blue is frequently found to have become green.

Gemini, see CONSTELLATIONS

Gendarme, member of a military police force formed in France in 1791 as a cavalry regiment. They were the King's bodyguard up to the time of Louis XVI. They became armed police after the French Revolution. The system was introduced into Germany in 1812, and now exists in many other countries. These police are generally controlled by the Minister of the Interior, but in France and in Italy, where they are called *carabinieri*, they are responsible to the Minister of War. In Spain they are called *Guardia civil*, and in Holland *Mararchausses*.

Genée, Adeline (Adeline Christiansen), was born near Aarhus, Denmark, in 1878, and made her debut as a dancer at the age of 10. She appeared in London (1897) and achieved an instant success. She was *prima ballerina* at Covent Garden, Daly's, and the Empire. Since her retirement (1914) she has made a single reappearance, to open the Coliseum ballet season in 1933, and a few weeks previously had made a television appearance. In 1928 she became President of the Association of Operatic Dancing of Great Britain.

General Assembly, see FREE CHURCH OF SCOTLAND

General Paralysis, see PARALYSIS

General Strike, a stoppage of labour in all or most industries at once by common action on the part of the workers. Although sympathetic strikes, with the object of strengthening

the hands of other workers in an associated industry, have been not infrequent, nothing meriting the title of "general strike" was experienced in England until 1926. In that year the General Council of the Trades Union Congress threatened national strike action if the wages of coalminers were reduced, as recommended by a Royal Commission. After the failure of negotiations this action was taken on May 4, and within a short time about one-and-a-half million workers had withdrawn, besides the 1 million coalminers originally involved. The Government rapidly organised a Press Service and supervised food distribution. Large numbers of volunteers were enlisted, and the Special Constabulary was increased by 130,000. Sailors were employed at the electric power-stations in London. Workers in different industries returned gradually, and the strike as a general strike was over before the end of the month. About £5 millions was expended by the Trade Unions in strike pay, and their strength in numbers, influence, and resources was considerably diminished as a result.

The general strike of 1926 was by some held to be anti-constitutional, and the subsequent Trades Dispute Act of 1927 made a general strike with the object of political coercion illegal.

Generations, Alternation of, the production from a sexual generation of an asexual generation, which in turn produces a new sexual one, and so on. It is commonly found in mosses, liverworts, and ferns, and in some of the lower animals. Occasionally in both plants and animals either the sexual or the asexual generation may be suppressed.

Generator, see ELECTRIC MOTOR

Genes, the units responsible for the development of the inherited characteristics of individuals, located in the chromosomes of the nucleus of any cell (*q.v.*). Genes are of special importance in the reproductive cells, which transmit them to new individuals. The term was introduced to supply

the explanation of the facts of genetics (qv) and heredity (qt)

Genesis the first book of the Old Testament so called from the opening words In the beginning The first few chapters give the stories of the Creation the Fall of Man and the Flood The following chapters give an account of the ancestors and patriarchs of the Israelites until their migration to Egypt under pressure of famine The book cannot be considered historical though when linked with other (archaeological) evidence it casts some light on the history of the Hebrew people

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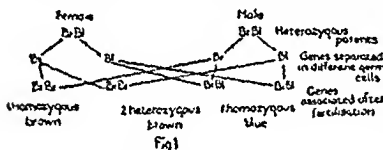
(1) Germ cells with the bro

factor may unite and the offspring will have pure brown eyes. These are technically described as pure dominant, or as homozygous with regard to the brown colour.

(2) Germ cells with the blue colour factor may fuse, and the children will be pure recessives, and homozygous with regard to the blue colour.

(3) A germ cell with genes for brown colour may fuse with one with genes for blueness, and the offspring will have impure, or heterozygous, brown eyes.

It will be seen from the diagram that the probability of this union is twice as great as of the others, and this is in accordance with the results Mendel obtained experimentally in breeding peas. Breeders wishing to propagate a recessive characteristic may obtain pure recessives by mating impure dominants, but never by mating pure



dominants. When dominant, D, and recessive, R, forms are mated, the recessive is always latent in the offspring. If these be mated with recessive forms, the next generation will consist half of impure dominant (DR) and half of pure recessive forms (RR). Similarly, no dominant forms can be obtained by breeding from pure recessive, but when pure and impure dominants are mated, the next generation consists of 50 per cent pure and 50 per cent impure dominant forms. The expectations warranted by Mendelian experiment are not always realised owing to a number of different phenomena. Some genes appear to have approximately equal potentialities, resulting in what is described as a blended inheritance. A red Japanese "four-o'clock" crossed with a white flower of the same kind results in the production of pink-flowered plants. Long and short-eared rabbits may,

when crossed, produce progeny ears of intermediate length. Three types of inheritance may be explained by the assumption that the germ contain different numbers of the factor for the characteristic under investigation. Thus, if two genes for red colour be present, a red "four-o'clock" results, if only one gene be present flowers are pink, and if there are no genes for redness, the flower is white. Similarly, two genes would account for long ears, a single gene for intermediate length and no genes for short ears.

Some characteristics have been found to be sex-linked and passed from mother to son and father to daughter. Colour-blindness, some forms of blindness, and hæmophilia, a condition in which clotting of the blood is impaired, take place and consequently ex-cessive bleeding occurs from even a scratch, are examples of sex-linked characteristics. Other characteristics have also been found to be linked, but groups rarely separable, so that breeding particularly for one characteristic, the others are also present. The existence of the genes and the difficulty of separating them is readily explained by the fact that the number of chromosomes in the nucleus is very small compared with the number of characteristics. Consequently, each chromosome must contain a large number of genes, and since the chromosomes retain their individuality through successive divisions, all the characteristics due to the genes of any particular chromosome are transmitted as a unit. Occasionally in nuclear division paired chromosomes become separated during their separation prior to their passage to opposite poles of the cell, and linkage is thus broken. This phenomenon, described as crossing over, can cause a change sufficiently great to produce a new species, and is often referred to by the breeder. Sex characteristics are carried on sex chromosomes, containing the

nants of sex. It is owing to sex linkage that in at least some strains the cattle breeder requiring good milk cows has to select his bull carefully for the determinant of the milk producing characteristic is linked in one of the sex chromosomes of the male. (See Heredity)

Another phenomenon important in breeding and interfering with the Mendelian type of heredity is the presence of lethal factors. When Dexter cattle are interbred the ratio of the types of offspring is one Kerry type (apparently the original parent stock of Dexter cattle) two Dexter and one described as bulldog. The latter is always stillborn and the simplest explanation seems to be that the Dexter type contains one of the two sets of genes essential to the bulldog type. When these two sets are brought together there is an interaction resulting eventually in the death of the individual. Similar results follow when yellow mice are interbred. Pure yellow mice never develop; the surviving yellow ones always contain the other colour factor, yellow being dominant. Lethal factors occur also in plants. In cattle breeding and in human reproduction families are often so small that the Mendelian ratio can not be manifested even when there are no interfering factors.

The chief reasons for breeding animals and plants are

(1) To obtain stock of the greatest economic value particularly with regard to food supplies. The improvement of root crops has been most marked since they have been judged by food content instead of shape. Cereals too are judged by quality of grain and not merely by size. Various cattle are bred for dairy produce, meat and hides; some birds for their egg-laying capacity, others as table birds, and pigeons as carriers. Horses are bred for strength to pull heavy loads and for swiftness. Research is in progress to produce species of grasses that will afford the best pasturage for cattle both in summer and winter.

(2) To raise plants and animals resistant to disease. Wheats and other cereals are frequently attacked by the rust fungi and experiment shows that some forms of wheat are less liable to attack than others. For many years experiments have been made to breed a strain immune to the rust disease and producing a good yield of grain. Collins has raised in America hybrids of maize and teosinte immune from attack by the corn aphid and giving a good yield of grain suitable for fodder. Breeding animals resistant to disease is a more difficult problem especially since natural selection which would ultimately eliminate the unfit is so often circumvented by medical aid. The veterinary surgeon and the physician cure many diseases and the propagation of non-resistant animals continues. In the case of men attempts are being made by some to secure legislation prohibiting the reproduction of the physically and mentally unfit. The branch of genetics particularly concerned with the propagation of healthy human beings is termed eugenics.

(3) Breeding is also carried out experimentally to produce individuals giving pleasure to man. Horticulture is the special branch dealing mainly with the production of beautiful flowers and plants. Horses and dogs are bred for racing; cats and dogs for beauty; toy dogs for novelty and for the companionship they afford.

(4) The breeding of animals under controlled conditions provides considerable information in genetics. For this reason many plants and animals are bred not because they are of direct importance to man but because they breed well in captivity and their development is suitably rapid to yield results during the lifetime of the investigator.

The disadvantages of inbreeding are often mentioned. Unless a stock is remarkably good inbreeding will in time result in the production of less vigorous individuals. Any weaknesses in the stock are likely to be perpetuated.

ated and accentuated by inbreeding, this is true also of the good qualities, and consequently crosses between the best inbred individuals may give remarkably good stock. Generally speaking, crosses between healthy individuals not closely related give the most vigorous progeny. Genetics is assisted by biometry, a mathematical investigation of variation and resemblances. Biometrical methods and representations indicate what may be expected of the average individual of a species, but afford no clue to modes of improvement either of individuals or of species. In England, genetics is investigated at the John Innes Institute, Merton Park, and breeding stations are attached to most of the universities. See also AGRICULTURE.

Geneva, canton in the S W corner of Switzerland, bounded by the canton of Vaud, the Lake of Geneva (*q v*), and France, area 108 sq m, pop (1930) 171,366. Geneva, the capital, has a pop of 142,812. Watered by the Rhone and numerous streams, the soil is fertile owing to persistent and careful cultivation. A considerable amount of fruit is grown, clocks, watches, and jewellery are the chief manufactures.

Geneva has for long been an intellectual centre, and is for ever linked with the names of Rousseau, Voltaire, and Calvin, the founder of the Academy which is now its university. It has been the headquarters of the League of Nations since its inception (1920).

Geneva, Lake of, or *Lac Léman*, largest lake in Switzerland, bounded on the W, N, and E by the cantons of Geneva, Vaud, and Valais, and on the S by the department of Haute-Savoie, France. It is traversed by the R Rhone. The lake is 50 m long and averages 5 m in width (maximum width 9½ m). On its shores are Geneva, Nyon, Lausanne, and Vevey (Switzerland), and Evian (France).

Geneva Convention, an international convention held at Geneva in 1864, at which the Powers agreed to respect

the persons and property of those tending the sick and wounded in battle.

Geneva Protocol (1924), see DISARMAMENTS.

Genghiz Khan [JHEN'HIZ KAN] (c 1160-1227), Mongol emperor, who succeeded when 13 years of age. His name was Temuchin, but he adopted the title of Genghiz, "perfect warrior," in 1206. He gained a succession of victories over the Naiman Mongols and the Kin Tata, his various armies conquering huge territories N and W of the Yellow Sea. His son Ogotai extended the Mongol empire to Russia and India.

Genu [JÉ'NEI], in classical mythology, spirits who guarded every person and place. Every human being had a genius (some said two—one good and one evil) attached to him (*cf* "guardian angels"); and most places had spirits who dwelt in them, hence the *chêché*, "the presiding genius." This must not be confused with a genius, a person of phenomenal intellectual powers (plus "geniuses"), nor with the genius in Eastern literature, which occupies positions in the spiritual hierarchy between angels and men. See also FAIRY.

Genoa, Italian city and seaport on the Gulf of Genoa. It has large iron foundries and shipbuilding yards, tanneries, cotton mills, and cement works, the manufacture of motor-cars is developing. Its 7 m of wharves, with latest mechanical devices for loading and unloading vessels, and an entirely reorganised system of dock labour, places it among the foremost of European ports. The two harbours cover c 600 acres.

The modernisation of the city has kept pace with its industrial and commercial development. The traffic problem has been circumvented by introducing three "tunnel" roads. One of the great modern engineering feats undertaken is the canalisation and covering-in of the R Bisagno. The problem of water supply has been

solved by the construction of an aqueduct in the Val Noci in the Genoese Apennines

Prominent among the new buildings are the Naval High School the School of Economics the health clinics the Archaeological Museum at Nervi and a gallery of modern art Of the ancient buildings of interest are the ancient seat of the Republic the Ducal Palace the 14th cent Temple of St Agostino and the extensive library of the Palazzo Bianco with its galleries rich in pictures by great Italian masters Genoa is a city of medieval palaces and very narrow streets Pop (1931) 608 100

Genoa Conference (1922) between 9 States of Europe including all the ex-enemy Powers except Turkey primarily to reestablish relations between Russia and the countries of Europe It actually broke down through the insistence of Belgium upon the restitution of foreign owned property in Russia But any possibility of success being achieved had been destroyed by the Rapallo Treaty (qv) between Germany and Russia settling outstanding political questions between the two countries The fears aroused by this treaty prevented agreement over a pact of non aggression which had been suggested by Lloyd George No decision could be made on the question of foreign property in Russia and the Conference broke up having achieved only some inconclusive resolutions in the field of economics

Genre, *see* ENGRAVING
Genserio (or *Gaiseric* d 47) greatest of the Vandal king He invaded Africa in 429 conquering almost the whole of Roman Africa in 6 years In 439 he took Carthage and made it his capital In 453 he sacked Rome carrying off the empress Eudoxia Before his death he had taken Sicily Sardinia Corsica and even parts of Egypt and Asia Minor

Gentian, a genus of plants named after Gentius an ancient king of

Illyria who discovered their medicinal value There are five English species The marsh gentian is an erect branched plant 6-12 in high bearing a few large bell shaped 3-cleft deep-blue flowers with five green stripes flowering Aug-Sept in boggy heaths The autumnal gentian has a salver shaped corolla fringed in the throat large and purplish the flowers expanding only in bright sunshine and a square leafy purplish stem it is common on dry chalky pastures The field gentian resembles the last but has 4-cleft corollas The gentians are among the most valuable of Alpines for the rock garden liking a peaty soil and flowering in profusion with flowers of a most beautiful and brilliant blue

Gentlemen's Magazine, The (the first magazine) a monthly publication founded by Edward Cave in 1731 survived in its original form until 1868 It contained brilliant historical and biographical articles Dr Johnson and Sylvanus Urban were contributors

Gentlemen at-Arms (The King's Bodyguard of the Honourable Corps of Gentlemen at Arms) a body of 39 officers decorated for war services derived from the pensioners of Henry VIII and founded in its present form in 1862 as first military bodyguard of the sovereign at official function and ceremonies It is headed by a captain who must be a peer and a member of the current Ministry The King's Bodyguard in Scotland is the Royal Company of Archers

Genus [jE NUS] biologically a group of related species (qv) Differences between genera are more striking than those between species and whereas species not infrequently interbreed genera rarely do so

Geocentric, *see* ASTRONOMY

Geodes, hollow tubes lined with one or more minerals found especially in igneous rocks In the first place a cavity formed in the rock, which as the water percolated through the surrounding rock became saturated with one

or more minerals and deposited them, either as crystals or, in massive form, as a lining to the cavity. The whole mass was dislodged as a nodule before the cavity became quite filled.

Geodesy, see SURVEYING

Geoffrey of Monmouth (1100?-1151), Welsh bishop and chronicler, author of *Historia Britonum* (c 1130). This famous work, on which many later histories of King Arthur and his Round Table are based, was mostly founded on tradition. It had an enormous influence on later English literature. See also ARTHURIAN LEGEND

Geoffroy Saint-Hilaire, Étienne and **Isidore**, two distinguished French zoologists, the former the father of the latter. **ÉTIENNE** (1772-1844) was appointed in 1793 Professor of Zoology at the Museum of Natural History in Paris, where, both independently and in collaboration with Georges Cuvier and his brother Frédéric Cuvier, he wrote many treatises, principally on the Mammalia. His chief publication, in conjunction with F Cuvier, was the *Histoire naturelle des Mammifères*. **ISIDORE** (1805-1861) succeeded him in his professorship, carried on his work, and was the founder and president of the Jardin d'Acclimatation at Paris.

Geographical Distribution of Animals.

This branch of zoology is intimately connected with geology and its story of the differences between the continents of past and present times, and of the extinct species which were the forerunners of existing animals. Unfortunately, the geological records are still imperfect, and there is great difference of opinion on many points, but it is generally agreed that land animals do not cross arms of the sea, even when comparatively narrow. Hence the occurrence of a species or two closely related species on blocks of land now separated by sea shows that they were formerly joined. From the existence, for instance, of wolves, foxes, bears, weasels, deer, sheep, etc., in Asia and N America, it is certain that these two continents were once united, and the closeness of the kinship between the

species shows that Bering Strait is of recent origin. This N Pacific land bridge also explains, with the help of fossil remains, the present distribution of the tapirs and camel family (qq) and of many other groups common to the Old and New Worlds.

But there are other groups common to these two hemispheres whose distribution cannot be thus accounted for. One of the families of scorpions, for instance, and certain very peculiar extinct tortoises, are found only in S America and Australia, and a well defined group of trapdoor spiders is restricted to Chile, S Africa, Madagascar, Australia, and New Zealand. Some zoologists, who believe that the continents and oceans, as we know them, have, with minor fluctuations, existed throughout the ages, explain these cases by the theory that the groups in question were at one time universally distributed, and have survived only in the countries where they are now found, although no explanation can be offered of their extermination elsewhere. Others believe that they unmistakably attest a former land connection between the continents of the S hemisphere. There is, moreover, a great deal of evidence from animals alone of a transatlantic land bridge between S America and Africa. For instance, the freshwater fishes of S America are strikingly different from those of N America, but are most nearly akin to those of Africa, whence they were no doubt derived.

It is known too from geological data that in the past there was a vast ancient continent which we call Gondwanaland (see GEOLOGY) stretching from S America to Africa, Arabia, India, and Australia, and that these countries, which since then have never been wholly submerged, were finally separated by subsidence of the Atlantic and Indian Oceans. The existence of Gondwanaland helps to explain the many resemblances between the animals and plants, both existing and extinct, of the S hemisphere, not only of old groups, but of comparatively

recent groups as well. Its N tropical coast line would account for the occurrence of siremans (*q t*) in Brazil Senegambia and the Indian Ocean and of king-crabs (*q v*) in the Caribbean and E Indian Seas. But many zoologists think that the S land bridges had disappeared before the Mammals could make use of them.

To the N of Gondwanaland and at various times joined to it here and there was another great continent which by invasion of the sea was periodically broken up into subsidiary

mammals except bats reached it. Australia also was severed but not before some primitive mammals the ancestors of its monotremes and marsupials had secured a footing and free from competition with the higher types of the N developed into the variety of species now found there. The fact that there are no marsupials elsewhere except in America suggests that Australia may have received its stock from that source. S America was probably invaded by marsupials from N America during the Cretaceous



Geographical Distribution of Animals.

a. Holarctic b. Ethiopian c. Neotropical d. Oceanic e. Australasian f. Antarctic

continents or islands but remained on the whole a continuous tract of land so that there was a repeated interchange of its animals from E. to W or vice versa.

Each of the great continents, as we know them has been the centre of the evolution of groups of animals which wandered some faster some slower into neighbouring lands when the chance offered, and there were extensive migrations from N to S and vice versa as well as those indicated above. These are well illustrated by the Mammals. New Zealand was isolated at so early a date that no land mam-

period and by the ancestors of its primitive extinct ungulates its porcupines and perhaps its edentates from Africa in the early Tertiary when it was separated from N America. The junction of the two continents in mid Tertiary times was followed by migration of a few indigenous S American species into N America e.g. the tree porcupine and by a great influx of dogs cats otters pigs deer llamas and the ancestors of the monkeys from N into S America.

Another great centre of evolution was Africa which like S America has a mixed fauna of indigenous species and

migrants from the N, it is not possible in all cases to say which. The hyraxes and elephants were evolved there, and the elephants migrated N nearly all over the world, but the giraffes, rhinoceroses, zebras, pigs, carnivores, monkeys, and apes probably came from Eurasia. A peculiarity of Africa is the absence of bears and deer, except in Morocco, which they reached from Europe, both these families invaded India and S.E. Asia, the fauna of which has otherwise much in common with Africa, with a mixture of distinct species and species of more N origin, but most of the E. Indian species do not pass E beyond a line, called "Wallace's Line," marked by a deep but narrow channel between Bali and Lombok, Borneo and Celebes, and roughly separating the Oriental from the Australian fauna.

Madagascar, originally a part of Gondwanaland, was comparatively early separated from Africa and India. Its fauna shows kinship with that of both countries, but has none of the higher types found in them.

The world has been divided into various zoological regions, but these do not apply to all groups of animals. These are the Holarctic, comprising Europe, N and Central Asia, and N America, the Ethiopian, or Africa S of the Sahara, the Oriental, stretching from India and S China to Wallace's Line, the Australian, and the Neotropical or S American, but N America is sometimes called the Nearctic and Europe and Asia the Palearctic.

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Geographical Glossary.

Aborigines the original or primitive inhabitants of any region, often applied to natives as opposed to foreign invaders or colonists.

Antipodes any part of the globe's

surface diametrically opposite given district (e.g. the Antipodes 1400 m. S.E. of New Zealand is the antipodes of the British Isles).

Archipelago [ARKEPELAGŌ] a group of islands, e.g. the Hebrides or the islands of the Aegean.

Arête [AR'ET] a steep angular mountain ridge, e.g. the pronounced N.E. ridge of the Matterhorn.

Arrondissement administrative or fiscal subdivision of a French department.

Atlas a collection of maps illustrating either the political divisions or relief of the contemporary world, or a period of the past (see MAP PROJECTION AND CARTOGRAPHY).

Atoll a circular or horseshoe-shaped coral island surrounding a lagoon (qv) with one or more openings to the sea.

Axle the hypothetical line about which the earth rotates, joining the N and S geographical poles.

Basin the drainage area of a river and its confluent, e.g. the plain of Lombardy forming the basin of the R. Po.

Bay a broad open indentation in the coast-line.

Bight a shallow even indentation in the sea coast, often of great width, e.g. the Great Australian Bight.

Bore a tidal wave produced in river estuaries by the rapid narrowing of the channel, visible on the Severn and Trent in England.

Campes the open grassy plains of S America similar to the N prairie (qv).

Canal a navigable artificial waterway. The commonest type links one river with another. Ship Canals are constructed to make an inland city into a port, e.g. Manchester Ship Canal, or to provide a waterway across an isthmus, e.g. Suez, Corinth and Panama Canals. In some cases, e.g. Panama Canal, the differences of water-level have to be surmounted by locks. On the Continent many important rivers are canalised by means of embankments, etc.

Cañon a deep ravine or valley with

precipitous sides made by the rapid flow of a river and the action of denudation e.g. Grand Canon of the Colorado R., U.S.A.

Capital chief city in a country usually the governmental head quarters

Carse name given in Scotland to a wide fertile valley e.g. Carse of Gowrie

Chart map showing configuration of the bed of the sea, ocean currents, lighthouses etc.

Coast the edge of land in contact with the sea

Col (Tr = neck) narrow high pass through a mountain chain formed by the meeting of river or glacier valleys from opposite sides of the range

Continental Shelf that part of a continental land mass which is continued under the sea in a gradual slope above which the ocean soundings do not exceed 100 fathoms. Islands rising above the continental shelf are classed as part of the adjoining continent

Contours lines in a map joining points of equal elevation

Cordillera (COR DIL YEM RA) Spanish term applied to a group of mountain ranges and specially to a series of parallel chains e.g. the mountains of Central America and the Andes

County originally the territorial jurisdiction of an earl or count, now a local government area in Great Britain, the U.S.A. and certain British Dominions and Colonies. The word is also used of the territorial divisions of Hungary

Defile See Pass

Degree 60 geographical or nautical miles, $\frac{1}{360}$ part of the earth's circumference measured along a line of latitude or longitude. A degree of latitude is practically constant 69.2 English miles of longitude decreasing from 60 m. at the Equator to vanishing point at the poles. At the latitude of London it is c. 43 m.

Delta alluvial triangular deposit formed at diverging mouths of a

river the stream forces its way round each side of the obstacle forming fresh mouths at which the process will be repeated e.g. the Nile delta. So-called because of a resemblance to *delta* the fourth letter of the Greek alphabet

Desert area of the earth's surface affording a minimum of subsistence to life and found mainly in either rainless areas or in regions where the temperatures are abnormally low e.g. in the trade wind belts or in the polar and sub-polar regions

Doldrums the belt of equatorial calms between the trade winds (q.v.) at certain season abounding in squalls and sudden thunderstorms

Eagre (E GEA) another name for bore (q.v.)

Embankment artificial ridge built to carry roads and railways over low land without abrupt change of level to traverse a swampy area and to check inundation also to keep a river or canal in its bed

Entrepot (ONTRE PO) a distributing centre of international commerce

Equator The imaginary circle drawn round the circumference of the earth midway between the N. and S. Poles its plane being at right angles to the axis (q.v.) See also LATITUDE

Estuary the broad mouth of a river which is affected by the tides or more strictly the region where sea and fresh water meet

Fall Line in the United States the line of junction between the Appalachian Mountains and the Atlantic plain

Firn alternative name for a glacier (q.v.) usually applied where snow (q.v.) predominates

Fjord (FJORD) long, narrow inlet resulting from the subsidence of a mountainous coast and the subsequent flooding of the valleys

Föhn a hot, dry local Alpine wind produced by the descent of an air current in passing over the mountain ranges and its subsequent heating by compression on being

- drawn into the denser valley atmosphere
- Gazetteer** dictionary and descriptive summary of the natural features, towns and cities, either of the whole world or of some particular region
- Geography** the scientific study of the general phenomena of the earth, especially in relation to the activities of man
- Geyser** [GE'ZLR or GI'ZLR] a volcanic boiling spring common in Iceland and New Zealand See separate article
- Ghats** [GAUWTS] name used in India for mountain passes, also applied to the steps leading down to a landing or bathing place on a river's banks See separate article
- Glacier** massive, crystalline blocks of ice, or snow and ice, found in the regions of perpetual snow and moving, by the force of gravity, slowly and irregularly down mountain slopes into the temperate valleys
- Globes** small spherical representations of the earth, giving the most accurate picture of the distribution and area of land and sea
- Grasslands**, Natural occur in those regions where rainfall is too scanty to support forest, but is just sufficient for the growth of grass and low shrubs, e.g. the steppes of Russia, the prairies of U.S.A., and the veldt in S. Africa
- Great Circle** line drawn on the surface of a globe whose plane passes through the centre of the sphere, e.g. all meridians of longitude are great circles, but parallels of latitude, except the Equator, are not
- Gulf-stream** the warm N.E. drift current of the N. Atlantic, originating from the equatorial drift (see ATLANTIC OCEAN, OCEANS and SEAS)
- Hachures** [HASH'oor] a term used in cartography for shading lines to indicate variations in height
- Hinterland** country lying immediately behind a coast, river, or frontier
- Horse Latitudes** a region of calms between the N.E. and S.E. Trade winds and the variable W. winds of the N. and S. hemispheres The belts shift with the seasonal movement of the sun
- Island** portion of land entirely surrounded by water, e.g. Great Britain, Ceylon, Madagascar.
- Isobar** [I'SO'BAR] line drawn upon a climatic map joining places at which the atmospheric pressure is the same in a given period
- Isobath** line linking points of equal depth in the ocean, serving the same purpose as a contour on a land map
- Isohyet** [I'SO'HI'ET] line joining places with equal rainfall over a given period
- Isotherm**, line linking places with an equal average temperature for a given period
- Lagoon** expanse of shallow water partially enclosed from the sea by a narrow spit of land, an invariable feature of coral islands.
- Lake** an expanse of water entirely enclosed by land
- Landes** local name for the dune-fringed Biscay coast of W. France
- Latitude** the position of any point on the surface of the globe expressed by the angle which a line drawn from it to the centre of the earth would make with the plane of the Equator expressed in degrees (*q.v.*) N or S
- Levee** [LEV'I] name given to embankments constructed to check the Mississippi floods
- Loch** [LOKH] Scottish term applied both to lakes (*q.v.*) and inlets. *Lough* is the equivalent Irish term
- Longitude** [LOU'JI'TUD], the distance in degrees of a place from a given meridian (*q.v.*), usually that of Greenwich
- Maidan** Persian term for an open space, generally used in India and adjacent lands to denote a wide plain
- Map** diagrammatic representation of the world or any part of it on a flat surface The science of map-making is known as *Cartography* (see MAP PROJECTION)
- Meridian** the great circle through any given point and the geographical

poles cutting the Equator at right angles

Monsoon seasonal wind occasioned by the deflection of permanent winds from their normal path through the heating of a neighbouring continental land mass

Mountain elevation of the earth's crust which exceeds 2000 ft above sea level lower eminences are termed *hills* Mountains are of two principal types—volcanic cones or folded chains—the latter being the result of contraction and consequent wrinkling of the earth's crust See also MOUNTAIN BUILDING

Névé [NĀ VĀ] snow which has become a hard crystalline mass but has not been compacted into solid ice

Oasis [Ō AS IS] an isolated patch of vegetation in a desert (q.v.) region

Ocean the entire expanse of salt water covering the face of the globe one of the large bodies of water into which this expanse is divided

Ordnance Survey geographical survey of the British Isles conducted by officials of the Ordnance Department Ordnance maps are the most accurate obtainable

Pampas the natural grasslands of S America

Pass a natural route across a mountain range (see COL) a very deep narrow pass is termed a *defile*

Plain flat or undulating stretch of country usually not more than 1000 ft above sea level

Plateau [PLANTŌ] or *Tableland* an elevated plain (q.v.) whose edges slope somewhat abruptly to a lower level

Port A place of call or harbour for ships and trading centres

Prairies the vast natural grasslands of the temperate regions of N America

Province large subordinate division of a country

Rapids any part of a river where the stream flows with exceptional speed occasioned by a drop in the

slope of the river bed or by constriction of the course of the stream

Relief the superficial details of any geographical area

Rift Valley a broad valley with abrupt containing walls e.g. the Scottish Lothlands and the rift valleys in Africa

Royal Burgh designation for such Scottish towns as date their charter of incorporation from a royal grant of mediæval times

Salinity the natural saltiness of seas, rivers or lakes

Savanna or Savannah natural grasslands of tropical regions between the equatorial forests and the tropical deserts

Selvas equatorial forests of the Amazon region

Shotts the shallow saline lakes peculiar to the middle Atlas region

Simoom a hot and dry wind prevailing in the deserts of Baluchistan Arabia and Sahara during the spring and summer months

Sirocco or Scirocco [SIROKŌ] warm S wind peculiar to the basin of the Mediterranean Sea

Steppes natural grasslands of SE Russia and SW Siberia

Sudd the mass of interlaced and decaying vegetation which obstructs the channels of the Equatorial Nile

Swamp level or low lying expanse of ground saturated with water

Taru small moorland or mountain lake

Topography detailed description of natural geographical features to names and particular regions

Town a centre of population supported chiefly by commerce or industry as distinct from a village or agricultural settlement

Trade Winds the winds permanently blowing from the tropics towards the Equator

Tropics The defined by latitudes 23° 30' N (Tropic of Cancer) and 23° 30' S (Tropic of Capricorn) parallels marking the limits N and S of the Equator at which the sun's

- rays can be vertical at noon (See *also* EARTH)
- Tundra** [roo-NDR] the frigid, marshy low-lying plain in those parts of Europe, Asia and America within the Arctic Circle
- Veld, or Veldt**, the natural grasslands of S Africa
- Volcano** a cone-shaped mountain formed by the cooling of molten rock erupted from the earth's interior through an aperture in the crust. Lava, ashes, sulphurous gas, and steam may be emitted
- Wallace's Line** the line dividing those regions of the E Indies with a characteristically Asiatic flora and fauna, from those where these features are Australian. The "line" runs NNE between the islands of Bali and Lombok, through Macassar Strait, and is continued to the SE of the Philippine Islands
- Waterfall** (Cataract or Cascade) the abrupt descent of flowing water over a cliff or precipice
- Watershed** a rise in the ground separating the drainage of rivers, known alternatively as a water parting
- Geography**, the branch of science which deals with the surface features of the earth, divided into physical and humanistic branches according to the aspect studied. It is connected on the one hand with astronomy, geology and biology, and on the other with ethnology, economics, and sociology. The modern method of studying geography is to survey the world country by country, considering (1) physical conditions, (2) the inhabitants, (3) reactions of the inhabitants to their environment, and a comparison with similar environments elsewhere, (4) the relation of the country to the world as a whole
- Geology**, the branch of science concerned with the study of the history of the earth and the changes it has undergone before reaching its present state. The various theories of the origin of the earth involve a consideration of astronomy, and are discussed in the article EARTH (qv). Geologists have, however, attempted to test the truth of the nebular hypothesis by a consideration of the earliest rocks and faunas and the type of climate they seem to indicate. Inasmuch as there is evidence of glacial conditions in the oldest fossiliferous rocks of China and Australia, it seems that the climate then was no hotter than now, and this is certainly not in favour of a nebular origin of the earth. On the other hand, it has been suggested that, on the planetesimal hypothesis, the heat of the earth at the present time may be due to the contraction of the mass of aggregated meteorites. The heat thus generated may even have been sufficient to melt the outer layers where the pressure was less. The earthy constituents would then separate from the metallic, which would form a central mass covered by a stony crust. Experiments to determine the density of the earth indicate that there is such a metallic core. The average weight of the surface rocks is $c 2\frac{1}{2}$ times that of an equal bulk of water, yet the whole earth is more than $5\frac{1}{2}$ times as heavy as a globe of water of equal size. Hence the materials at the centre must be twice as heavy as those on the surface, and are probably, therefore, largely metallic.
- This hypothesis is supported by the evidence of earthquake waves, which have been shown to travel through the centre of the earth at a speed three times as great as their velocity through the outer crust, the thickness of which has been variously computed, but is probably $c 10$ m.
- The original rocks of the earth's crust were no doubt the solidified primary molten material, and hence are called primary rocks. By denudation and re-deposition these gave rise to the secondary or stratified rocks, which are usually fossiliferous, and by various processes representatives of each of these great groups of rocks may be altered to form rock types which are grouped in a third great class, the metamorphic rocks (see Rocks). The primary rocky crust is

regarded as having been composed of two layers an upper rich in quartz and composed of acid rocks and a lower consisting of basic rocks and composed of heavier minerals such as iron and magnesium. It is this double layered composition that furnishes an explanation of the maintenance of the level of the land throughout geological time. The theory of isostasy envisages the continental blocks as composed of lighter acid material floating in the heavier basic material which forms a basaltic substratum and postulates that equal masses must underlie equal areas. Hence the material underlying continents must be lighter than that beneath oceans in order to compensate for the added weight of the land above the surface and the lighter acidic material projects into the basaltic below to a depth proportionate to the weight of the continent somewhat after the manner of an iceberg which has nine tenths of its bulk below the surface of the sea. The deposition of a large delta or the formation of an ice-sheet by loading the crust tends to depress the land while erosion of the land masses makes for upward movement. Isostatic compensation is probably responsible for many earthquakes and other crustal disturbances mountain building etc.

Elevation of mountains seems to have taken place at regular intervals of geological time the periods of disturbance being separated by long periods of comparative quiet. It was suggested by Joly that this rhythm was due to alternate melting and freezing of the basalt substratum. The heat emitted by radioactive minerals would accumulate in the crust and in time melt the basalt causing sinking of the continents with corresponding elevation of the ocean floors. The heat would soon be dissipated by convection currents and solidification would ensue favouring emergence of the continents. These movements due to isostasy are most in evidence along coast lines where they can be

measured by the level of the sea and are shown by raised beaches submerged forests and drowned valleys fjord etc. Connected with the theory of isostasy is the *Continental-drift* theory of Wegener. He regarded the basalt substratum as a viscous fluid in which the continental block drifted W and with a general tendency towards the Equator. Thus America broke away from Europe and Africa and drifted W faster than the continents of the Old World. The shape of S America and Africa accords with this idea as does also the distribution of various geographical features and geological strata and still more the distribution of certain plants and animals. Nevertheless the theory is by no means proven.

Even more ingenious is the *tetrahedron*

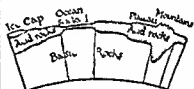


Fig showing condition of Isostatic Equilibrium. (After Willis.)

of theory. It is assumed that the internal mass of the earth is shrinking more than the rigid crust and so there is a tendency for an excess of surface. Now the symmetrical solid figure that has the largest possible surface for any given volume is the tetrahedron or pyramid and so the strain is relieved best by an assumption of the tetrahedral shape. Hence there is a tendency for flattening of the surface at four points corresponding to the faces of the pyramid and in the slight hollows thus formed the major oceans, the Arctic, Atlantic, Indian and Pacific collected. The rotation of the earth prevents the flattening being very pronounced. On this hypothesis the continents would be at the corners of the pyramid each opposite an ocean and this antipodal arrangement of oceans and continents is a too easily seen

on the surface of the earth. When the flattening was sufficient to render the conditions unstable the rotation of the earth would cause buckling of the edges of the pyramid and the spheroidal form would be regained, though the earth would be slightly smaller than before the tetrahedral period.

Geological history seems to furnish evidence for the alternation of periods of flattening and recovery. The main divisions of geological time are

Era	Period
Quaternary	{ Recent or Holocene Pleistocene
Tertiary or Cainozoic	{ Pliocene Miocene Oligocene Eocene
Mesozoic or Secondary	{ Cretaceous Jurassic Triassic*
Paleozoic or Primary	{ Permian Carboniferous Devonian Silurian Ordovician Cambrian
Pre-Cambrian, Eozoic, or Archaean	

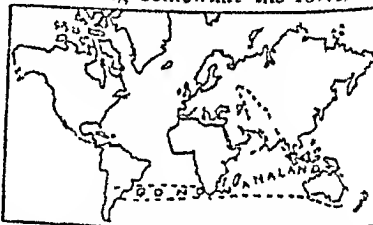
* Sometimes included in Jurassic or Triassic

Little is known of conditions in the pre-Cambrian, in which, so far as is known, life was absent, but it seems to have been a time of general disturbance, accompanied by volcanic activity, which died away during the Cambrian, only to be renewed in the Ordovician, and this fresh vulcanicity was followed by another quiet period during the Silurian. The Devonian was another volcanic period, but, on the whole, the early Carboniferous was tranquil, while the late Carboniferous and Permian showed yet another burst of vulcanicity. Then came a long period of quiet, all through the Mesozoic Era, followed by great earth-movement and mountain-building during the Tertiary. The quiescent periods were probably times when the earth's crust was trying to fit itself to the shrinking interior by gentle subsidence. This would obviously become impossible after a time, where-

upon great earth-movements accompanied by fractures would set in a volcanic material would be forced through the fissures.

Now, if the tetrahedral theory correct, there should be three lines representing the vertical edges of the pyramid, running N and S and separated by a distance equal to one third of the earth's circumference along which continents would tend to occur. There should also be three such lines, marking out the fourth face of the pyramid running in horizontal alignment round either the N or S pole.

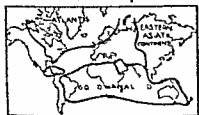
In the first volcanic period, the Ordovician, this arrangement is indicated, the distribution of land and water being somewhat the reverse of



Map showing the estimated extent of Gondwanaland (after J W Gregory)

that obtaining to-day. An Arctic continent was antipodal to an Antarctic ocean. A great land mass was over Manchuria and the N Pacific, and was antipodal to a sea in the S Atlantic. Over the site of the present Indian Ocean was another land mass, extending N through Africa and E towards Australia, and being opposite a sea which almost covered N America. S America was like the present continent inverted, tapering to the N and being connected with Greenland. In late Carboniferous and Permian times this arrangement to some extent was repeated. A great continent, called Gondwanaland, stretched from S America, through S Africa, to India and Australia, and was characterised by a special type of vegetation, the *Glossopteris* Flora (*qv*), and by

the occurrence of widely distributed glaciation. The vegetation at this time consisted of the plants which



Glacial centers 100,000 years ago (After J. W. Gregory)

formed the coal beds. An Arctic continent and Antarctic sea were in existence. Land covered Britain and N. Europe in general and there was a continent lying to the N. of Australia.

From this deformation the earth slowly recovered its spheroidal form during the Mesozoic Era. Gentle raising of the ocean floors led to an extension of the sea in most areas which submerged the existing continents. It was during the disturbances at the close of the Mesozoic that sinking of parts of the earth's crust probably formed the present Arctic and N. Atlantic Oceans. The last period of disturbance in the Miocene saw the formation of the Alps, Caucasus, Himalayas, Rocky Mountains and Andes and the establishment of the outlines of the present continents.

These continents are composed of three types of rock masses: (1) Massive blocks of the earth's crust composed of very old rocks which have been above sea level throughout geological time. Such blocks form Scandinavia, Peninsular India, Labrador, part of E. Brazil, a large part of W. Australia and a good deal of Central Africa. (2) Crumpled bands or fold mountains, of which there are an old and a new series: the old much broken forming the central plateau of France, parts of Germany, the Bohemian plateau, the Appalachian Mountains, and the Cornish hills; and the new of the Alps and Himalayas and

the girdle of mountains including the Andes and Rocky Mountains which encircle the Pacific and include the chief volcanoes. (3) Sheets of sediments which occupy the ground between the higher lands and are comparatively recent and liable to inundation due to earth movement.

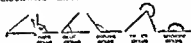
Geometric Progression *see* ALGEBRA
Geometry the study of lines, angles, surfaces, areas, curves and solid figures such as the cube, sphere, etc. The more important branches of this subject are Analytical and Co-ordinate Geometry, Euclidean, Non-Euclidean, Line, Projective and Solid Geometry. The branches together with the chief terms employed are explained below.

Abscissa *See* COORDINATE GEOMETRY

Alternate Angles *See* PARALLEL LINES

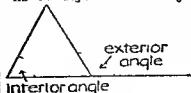
Analytical Geometry *See* COORDINATE GEOMETRY

Angle If two lines OA and OB in the diagram be connected at the point O and the line OB rotates in an anti-clockwise direction the amount of



rotation is called the *angle* BOA. If the line OB makes a complete revolution and comes back to its original position O or O1 this angle is a complete circle and is called 360 degrees (written 360°). An angle of 90° or a quarter of a circle is a *right angle* and the two lines which make the angle are said to be *perpendicular* to each other.

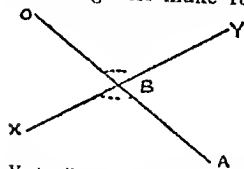
An *acute angle* is less than a right



angle and an *obtuse* angle is greater than a right angle. A *reflex* angle is greater than 2 right angles. A *straight* angle is 2 right angles, or 180° .

Angles, Complementary Two angles which together make 90° .

Angles, Supplementary Two angles which together make 180° .



Vertically Opposite Angles

Angles, Vertically Opposite
When 2 lines OA and XY cut each other, the angles OBY, XBA are

equal, and are called vertically opposite.

Arc A portion of the circumference of a circle.

Asymptote A term used in co-ordinate geometry. A line which approaches nearer and nearer to a curve, but touches it only at infinity.

Axiom A self-evident statement, used in Euclidean geometry, e.g. things which are equal to the same thing are equal to one another.

Axis See CO-ORDINATE GEOMETRY.

Base See TRIANGLE.

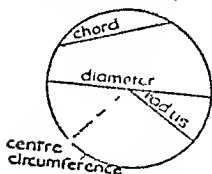
Bisector A line dividing another line or an angle into 2 equal parts.

Catenary See CURVES.

Centre See CIRCLE.

Chord A straight line joining 2 points on the circumference of a circle.

Circle A figure enclosed by a curved line, the path of a point which moves so that it is always at the same distance from another fixed point, called the *centre*.



cone

The distance between the two points is the *radius* of the circle, and a straight line through the centre and cut off by

the circumference is the *diameter*. The *circumference* is the curved line which encloses the circle.

Collinear In the same straight line.

Concurrent Lines which all meet at a point are said to be concurrent.

Cone A tapering solid figure, the base of which is a circle and the top a point.

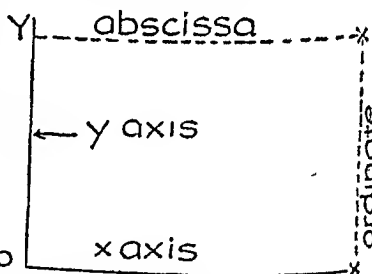
Cone A tapering solid figure, the base of which is a circle and the top a point.

Congruent, Congruence Two geometrical figures which are exactly equal to one another are said to be congruent.

Cone Section A curve obtained when a plane surface cuts a cone.

See CO-ORDINATE GEOMETRY.

Co-ordinate Geometry The study



of geometrical figures with the aid of algebraic analysis. All figures are drawn with reference to two perpendicular lines, called *axes*, and the distances of a point from these lines are the *co-ordinates* of the point. The vertical distance from the horizontal line is the *ordinate* and the horizontal distance from the vertical line is the *abscissa*. Curves of any shape can be expressed in the form of algebraic expressions and geometrical problems thereby transformed into algebraic problems. The more usual curves dealt with are the straight line, circle, and conic sections, i.e. *ellipse*, *parabola*, and *hyperbola* (see CURVES). Co-ordinate geometry can also deal with solid figures such as the *sphere*, etc., and in this case 3 axes are taken

which are all perpendicular to each other i.e. one vertical one horizontal N-S and another also horizontal E-W For a fuller treatment of the subject see any standard work e.g. Briggs and Bryan *Co-ordinate Geometry* Loney *Co-ordinate Geometry*

Cube A rectangular solid whose length breadth and height are all equal.

Curves The best known type of curve is the circle but there are many other curves which play an important part in mathematics

Catenary The curve formed by hanging up a chain or string from its ends

Cycloid The path of a point on the circumference of a circle which is rolling along a line

Ellipse A curve in co-ordinate



geometry of the shape shown and whose equation is

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

Epicycloid The path of a point on the circumference of a circle which



is rolling inside or outside another circle

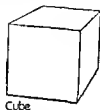
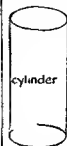
Hyperbola A curve in co-ordinate geometry of the shape shown and whose equation is

$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$$

Parabola A curve in co-ordinate geometry whose equation is

$$y^2 = ax$$

Cylinder A solid figure all sections of which perpendicular to the central axis are circles of equal diameter



Degree See ANGLE

Diagonal A line drawn from one corner of a figure to the opposite corner

Diameter See CIRCLE

Directrix A term used in co-ordinate geometry a particular line in a conic curve

Euclidean Geometry This is the well known formal geometry in which beginning from certain axioms and definitions various properties of angles lines triangles and circles are deduced Each property or statement about a geometrical figure is called a proposition or theorem and each proposition leads to a more advanced proposition The study begins from the point and the line and leads up to triangles and circles For fuller details see any standard book on the subject such as Baker and Bourne *Elementary Geometry* Hall and Stevens *School Geometry*

Exterior Angle See TRIANGLE

Helix A curve shaped like the thread of a screw or a spiral staircase

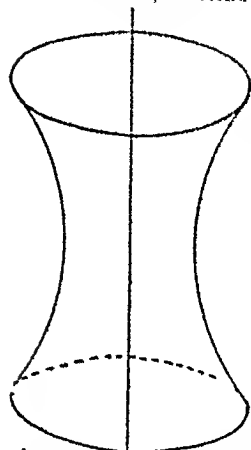
Hyperboloid A solid figure of the shape shown and derived from the hyperbola.

Isosceles See TRIANGLE

Hypothesis See THEOREM

Interior Angle An angle inside a rectilinear figure

Line Length without breadth



hyperboloid

Line Geometry A branch of geometry in which all figures and surfaces are regarded as having been formed by a line rotating round some axis

It can be applied to the study of imaginary figures in more than three dimensions

Locus

The path of a point which moves according to special conditions

Manifolds Geometrical surfaces which have been twisted or distorted, e.g. of the kind obtained by twisting a rectangular strip of paper and then bringing the ends together. Their study is connected with Riemannian Geometry and Einstein's theory of relativity.

Median The line joining a point of a triangle to the middle point of the opposite side

Mensuration Calculation of areas. The following are the areas of the more important figures

Circle π square of radius
($\pi = 3\frac{1}{7}$ approx)

Rectangle or Parallelogram length \times height

Trapezium half sum of parallel sides \times perpendicular distance between them

Triangle half base \times height

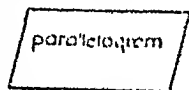
Non-Euclidean Geometry A modern development of geometry which has arisen from attempts to correct some of the axioms employed by Euclid in

Euclidean geometry, which is called "parabolic" Modern geometry is "hyperbolic" or "elliptic" and is closely connected with the four-dimensional geometry of Riemann and Einstein

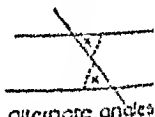
Obtuse See ANGLE

Parabola See CURVES

Parallel Line Lines which never meet. When two parallel lines are cut by a third line, the alternate angles made are equal.



parallelogram



alternate angles

Parallelepiped A solid figure every face of which is a parallelogram.

Parallelogram A figure bounded by 2 pairs of parallel lines

Perimeter The boundary line of a figure

Perpendicular See ANGLE

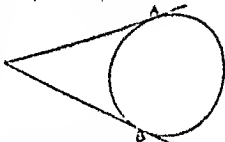
π (π) The ratio between the circumference of a circle and the diameter. Approximately equal to $3\frac{1}{7}$

Point In Euclidean geometry, that which marks a position but has no magnitude

Pole and Polar If from a point O two tangents OA, OB be drawn to a circle, the

point O is called the pole of AB and the latter is called the polar of O

pole and polar



Polygon A geometrical figure bounded by several straight lines. In a regular polygon the sides are all equal

Projection The projection of one line on another is that part of it which is cut off by lines drawn from the ends of the first line and perpendicular to the second

Projective Geometry A branch of geometry in which figures are drawn in

perspective as they would actually appear to an observer

Protractor A geometrical instrument for measuring angles

Pyramid A solid figure the base of which is a triangle (or other rectilinear figure) and the top a point

Pythagoras' Theorem of A well known theorem named after its discoverer which states that the square on the hypotenuse of a right angled triangle is equal to the sum of the squares on the other two sides

Quadrilateral A 4 sided figure

Q.E.D. Abbreviation for *quod erat demonstrandum* meaning which was to be proved and sometime written at the end of the proof of a theorem

Radius See CIRCLE



rectangle



rhombus

Rectangle A 4 sided figure with all its angles right angles

Reductio ad absurdum A method of proof in which it is shown that if the theorem is not true an absurd result e.g. that a smaller quantity equals a larger quantity is obtained

Reflex See ANGLE

Rhombus A parallelogram whose sides but not its angles are all equal

Riemannian Geometry A branch of geometry named after Riemann a German mathematician Space is considered as a particular case of a manifold and is considered to have curvature The application of tensor calculus to this conception led Einstein to his theory of relativity



Secant A line of indefinite length which cuts a circle

Sector Part of a circle bounded by two radii and the arc between them

Segment Part of a circle bounded by a chord and the arc cut off by the chord

Semicircle Half a circle

Similar Figures are those whose angles are the same but whose sides are unequal

Singular Points The

vertex of cones formed by the rotation of 2 intersecting lines. Used in

Geometry

Sphere A solid formed by the rotation of a circle round a diameter

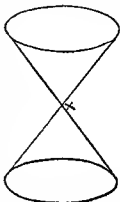
Spheroid A solid formed by the rotation of an ellipse about an axis

Square A rectangle whose sides are all equal

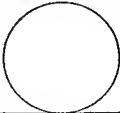
Supplementary See ANGLES SUPPLEMENTARY

Tangent A line which touches a circle or which may be considered to cut it at two coincident points.

Theorem A statement with reference to some particular property of a geometrical figure. Certain data are assumed thus being the hypothesis and any lines which it is necessary to draw in order to prove the theorem are the construction. The proof is then

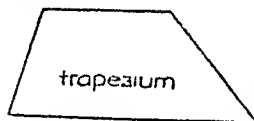


x singular points



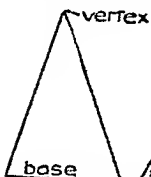
tangent

reasoned from the hypothesis and construction



Trapezium
A figure bounded by 4 sides, 2 of which are parallel

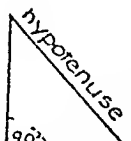
Triangle A 3-sided figure. When 2 of its sides are equal it is isosceles, and when all its sides are equal it is



isosceles triangle



equilateral triangle



right-angled triangle

equilateral. The top point is called the vertex or apex, and the bottom line is the base. A right-angled triangle has one of its angles equal to a right angle. The angle between any side and the adjacent side produced is called an exterior angle. In a right-angled triangle, the side opposite the right angle is called the hypotenuse.

Trigonometry An algebraic analysis and methods of calculating the angles and sides of a triangle. See **TRIGONOMETRY** (Section VI).

Vertex See **TRIANGLE**.

Vertically Opposite See **ANGLES**.

Geophysics, the science of physics as applied to the earth. Cavendish (see **GRAVITATION**) deduced the value of the gravitational constant, that is to say, the attraction between unit masses unit distance apart. Given the radius of the earth (3960 m), its mass can be calculated, and is found to be 6×10^{27} grammes or 6×10^{24} (6 followed by 21 noughts) tons, dividing this by the volume of the earth, its average density as compared with water is found to be $c. 5.5$. This density is greater than the average of the rocks forming the crust, and there can be little doubt that the central part of the earth consists

largely of metals, probably iron and nickel, since these are the main constituents of meteorites (*qv*), which are not of a rocky character.

The nature of the interior of the earth can be investigated only by indirect methods, since the depth to which boring is possible is quite insignificant. One of the most important sources of data regarding the interior of the earth is given by the observation of earthquake waves (see **SEISMOLOGY**). An earthquake causes elastic waves of two kinds, longitudinal and transverse, to travel through the earth (see **WAVES**). When these arrive at a point at which the density or nature of the earth changes, they are reflected and refracted. We are able to observe the nature of these waves, and their times of arrival at different parts of the earth. The science of the interpretation of the observations is extremely complicated, for not only is the constitution of the earth's interior unknown, but it is not certain whether the properties of its various parts, deduced from the way in which the waves travel, are to be ascribed to substances, the elastic constants of which we can measure.

Another source of information is given by observation of the effect of the moon's attraction upon the earth. The tides of the sea are due partly to this cause, and they result in the loading of the earth's surface being changed. But the same force is also acting upon the solid structure of the earth, which does not yield so much as a liquid, but is nevertheless deformed. The amount of this deformation can be measured by observing the effect of the attraction of the sun and moon upon a long tube of water. There will be a tide in this, very much smaller in its rise and fall than the tides of the sea, but amenable to exact calculation. If the earth itself is deformed, the tide will not be so great, and by observing the difference between the tide expected and that actually found, it is possible to determine how much the earth has

yielded. This experiment was performed by Michelson (*qv*) who used his interferometer (*qv*) to observe the very slight motion of the surface of water in a tube 12 metres long. The earth as a whole appears to be about as rigid as steel while for other reasons we know that the rocks forming the crust are more rigid than steel. This leads to the inference that the interior of the earth is probably liquid.

The distribution of radioactive matter in the earth is an interesting problem in connection with the internal heat of the earth. Although the amount is minute far more heat would be developed than is actually observed if the whole interior were as radioactive as the surface rocks. Conclusions can be drawn concerning the age of minerals containing radioactive matter from their composition, the number of years which must have elapsed since the formation of the mineral being deducible from the quantity of products of radioactive disintegration found. See also EARTH; GEOLOGY; GRAVITATION; MAGNETISM; RADIOACTIVITY.

George St. patron saint of England and of Portugal was taken by Edward III as the protector of the Order of the Garter. He is thought to have been a martyr, a Cappadocian Christian (d. 303). His sign is a red cross on a white ground and forms part of the Union Jack. He certainly did not kill a dragon as legend claims but near the place of his martyrdom (Lydda in Palestine) Perseus (*qv*) was said to have slain the sea monster and this feat was probably transferred as often happened from the pagan to the Christian hero.

George I (1660-1727) King of Great Britain and Ireland succeeded to the Crown (1714) through the death of his mother Sophia (granddaughter of James II) and of Queen Ann. The unsuccessful attempt on the throne by the Pretender son of James II in the 1715 rebellion ended in the defeat of the king and his Whig

friends were the more firmly established in power. Stanhope and Towns end were his first advisers but on their deaths in 1711 and 1722 respectively Sir Robert Walpole took their place and pursued the policy which aided by the Royal indifference to the country's politics enabled the Whig ascendancy to be more strongly established than ever. George spoke no English in his art and interest were in his hereditary electorate of Hanover. He had one son who succeeded him as George II and one daughter.

George II (1683-1760) King of Great Britain and Ireland in succession (1727) to George I whose minister Horace Walpole remained in power mainly owing to Queen Caroline's adulation. George II a soldier rather than a politician allowed his Prime Minister a free hand. Walpole resigned in 1742 over the war with Spain. In the war of the Austrian Succession George II concluded a treaty with France about which his ministers were not even consulted. After the battle of Dettingen he supported Maria Theresa in total disregard of the feeling of the country. Later however he recognised by the appointment of Pelham as Prime Minister that he could not arbitrarily appoint and dismiss his ministers. Of his 8 children 3 predeceased him.

George III (1738-1800) King of Great Britain and Ireland son of Frederick Prince of Wales and grand son of George II. His youthful education though received at the hands of many different tutors (his father died when he was 13) was based on Bolingbroke's *Letters*. The result was a determination to overthrow the Whig oligarchy established during the two previous reigns. On his accession he founded the *Asiatick Society* whom he pitted against the powerful Whig aristocracy, chose his own minister and gradually regained for the throne much of its former power. His great chance of moulding the policy of the country to his own ambitions came with the war with America (1763-65). His

bold and independent course impressed the people, until the subsequent disasters, together with the conduct of the heir to the throne, reversed their attitude. Moreover, his practice of buying subservience in Parliament was strongly criticised. The surrender of Yorktown and the resignation of North at last convinced him of the failure of his policy and he twice threatened abdication.

William Pitt followed Rockingham and Shelburne as Prime Minister, and during his periods of office the King's conduct became constitutional and his popularity was restored. In 1788 his madness, which had been intermittently apparent, became suddenly acute, and the controversies over the Regency Bill began. He recovered a year later, only to suffer successive relapses, until in 1811 he became permanently insane, and the Bill was passed. He died 9 years later. Unlike George I and II, he was essentially patriotic, a brave and popular king. His wife, Charlotte of Mecklenburg-Strelitz, whom he married in 1761, bore him 9 sons and 6 daughters.

George IV (1762-1830), King of Great Britain and Ireland, eldest son of George III. A personable and accomplished youth, he was subjected to a strict early upbringing which resulted in a later tendency towards a gay and profligate existence. Besides annoying his father by his loose living, he still further estranged him by choosing his male friends among Whigs, notably Fox and Sheridan. His relations with Mrs Fitzherbert began when he was in his early twenties. She was a Roman Catholic, to marry whom would by the Act of Settlement mean forfeiting his right to the throne. Nevertheless, they were married secretly in 1785. The relationship continued until c. 1811, when he transferred his affections to Lady Hertford. In the same year his father's insanity made him prince regent and in 1820 he became king in name as well as in fact. Soon after his ascent to the throne, the essential vulgarity of the "first gentle-

man of Europe" again manifested itself in his shameful treatment of his wife Caroline, whom he had married in 1795, and ill-treated for years, and whose honour he now impugned, to the disgust of his people. The climax of this painful affair was the rejected Queen's vain attempt to force her way into Westminster Abbey on the occasion of the coronation in 1821. She died a year later. Entirely lacking the strength of his father, George had perforce to accept Canning as Prime Minister while wholeheartedly disapproving of the man and his policy, and to accede to the Catholic Emancipation Bill (1829), after ineffectually opposing it. He was succeeded by his brother, the Duke of Clarence (William IV).

George V (George Frederick Ernest Albert, b. 1865), King of Great Britain and Ireland, and of the British Dominions beyond the seas, Emperor of India, the 2nd son of King Edward VII.



H.M. King George V

He was born at Marlborough House London and after training as a naval cadet cruised on *HMS Bacchante* as a midshipman with his brother Prince Albert. He pursued a naval career until he became heir apparent on the death of the Duke of Clarence in 1892. In the same year he was created Duke of York and in 1893 married Princess Victoria Mary of Teck. In 1901 he was created Prince of Wales and in 1910 succeeded his father as George V the coronation taking place on June 2, 1911. At the end of the year Their Majesties were crowned at Delhi. In 1917 during the World War it was announced that the German titles of the Royal Family would be renounced and that the name of the Royal House would henceforth be Windsor.

During the War the King frequently visited France and in 1917 was accompanied by the Queen. In 1933 they visited Rome and were received by the Pope. The following year the King opened the British Empire Exhibition at Wembley. In Nov. 1938 he contracted pleurisy and was seriously ill for 2 months but after a period of acute national anxiety he made a remarkable recovery. His conscientiousness and public spirit together with his kindly nature and simple tastes have won him the deep respect and loyalty of his people.

George, Henry (1839-1897) American economist exponent of the *Sin* Tax settled in California as a journalist in 1858. In 1860 he removed to New York, where he met with wide support. He proposed the concentration of all taxes on land rent for the equal benefit of the community. He was author of *Progress and Poverty* (1892) and *Protection and Free Trade* (1886). He gained support in America, Britain, Australia and New Zealand but nowhere have his proposals been put into practice. See LAND TAXATION.

George, Stefan (1868-1933) German poet founder of the individualist school of modern German literature. He started his journal *Blätter für die*

Kunst in 1897. He was influenced by Mallarmé, Nietzsche and the Pre-Raphaelites and his works which include *The Year of the Soul* (1897), *The Poetry of Life* (1899), *The War* (1917) and *The Souls* (1921) are notable for their political artistry.

Georgetown, seaport and capital of British Guiana near the mouth of the Demerara R. It carries on an active shipping trade in sugar, cocoa, coffee and rum. The harbour has been improved. There are two cathedrals.



Magnolia and Georgia.

in the town Protestant and Roman Catholic. Pop. 6,000.

Georgia (1) Soviet republic in Transcaucasia, a part of the USSR, bounded N. by the Caucasus, E. by Armenia and Azerbaijan, and W. by the Black Sea. The land is fertile yielding large crops of wheat, barley, fruit, tobacco, maize, rice and cotton. It is heavily timbered but owing to inadequate means of communication is not commercially developed. The mineral deposits are varied, manganese forming the chief output. Manufactures are small and chiefly for local needs with the exception of the silk

industry, which is steadily increasing. For 2000 years Georgia retained its independence until annexed by Russia 1801. Regaining its independence in 1914 it became in 1922 a member of the Transcaucasian Federation of Soviet Republics, together with Armenia and Azerbaijan. It is the capital Area 27 100 sq m, pop of republic 2 921 600.

(2) A S State of the U S A, named after George III, one of the original 13 States. The climate fluctuates from the cool of the hills to the warmth of the Florida zone and embraces all but one of the climate belts associated with the United States. Equally variable are the soils, red and brown loam, red clay and a grey sandy soil with a subsoil of yellow loam. Mineral deposits are meagre, of these fuller's earth, stone, and bauxite are the most important. There is a flourishing brick and tile industry. It is from agriculture, cotton, and live stock that the main resources of the State are derived. Most of the Negro farmers grow cotton only, Georgia ranking second among the States for cotton production. Rice, sweet potatoes, wheat, particularly in the N., Indian corn, and tobacco are also cultivated. The chief industry is the manufacture of cotton goods. Timber and cottonseed cake are other productive sources of revenue and means of employment.

The main rivers are the Chattahoochee and Flint, and the principal port Savannah. In 1932 there were 6672 m of steam railway and 7131 m of State roads. The three largest towns are the capital, Atlanta (pop (1930) 270,366), Savannah (85 000), and Augusta (60,342). Education is compulsory, and there are separate schools for whites and Negroes. A Senate and House of Representatives form the General Assembly, the members of which are elected every 2 years. In Congress Georgia is represented by 2 Senators and 10 representatives, and order within the State is maintained by a National Guard of 3738 officers and

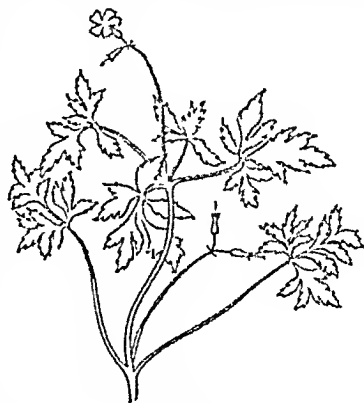
men Area, 59,265 sq m, pop (1930) 2,908,500.

Gephyrea, a zoological name applied until comparatively recently to several marine animals now known to be unrelated. The so-called armed gephyreans, or *Echinuridea*, are aberrant Appendix; the unarmed gephyreans, or *Sipunculoides*, are of doubtful affinity, whereas a third group, the *Phoronidea*, are now regarded as akin to *Balanoglossus* (qv) or sometimes as a distinct phylum of the animal kingdom.

Geranial (*citril*), a pleasant-smelling aldehyde of boiling-point 226° C., which occurs in various essential oils. It is usually obtained from lemon-grass oil, and is used in the manufacture of perfumes. It can also be obtained by the oxidation of geraniol (qv).

Geraniol, a pleasant-smelling alcohol found in a number of essential oils. The chief source is geranium oil. The liquid boils at 230° C., it is used in the manufacture of perfumes and for the manufacture (by oxidation) of geranial (*citril*) (qv).

Geranium (*Crane's Bill*). There are 12 wild species of geranium in England, including herb robert and meadow



Herb Robert

crane's bill. The geraniums are widely scattered over all zones, and there are

many in cultivation. A very few require the pit or greenhouse in winter and these should have equal portions of peat, loam, leaf mould and sand. Almost all are hardy and flourish in common ground; many will grow under the shade of trees and hedges.

Geranium Family. The plants of this order are astringent and aromatic. The root of *Geranium maculatum* or alum root, is a most powerful astringent. The tuberous roots of some such as *Pelargonium* are edible. The species of *pelargonium* which are natives of S. Africa are remarkable for the beauty of their flowers which have been developed by horticultural methods of selection, hybridisation, etc. *Geranium* is a popular name often also applied to window box *pelargoniums* but the groups are distinct.

Geranium. Flowers regular without a tubular nectary. Stamens 10. Plants mostly quite hardy.

Pelargonium. Flowers irregular the upper two petals being distinct from the lower three. The posterior sepal has a spur or nectary running down the stalk of the flower. Stamens 10 but 3, 4 or 8 of them may be without anthers. All require greenhouse protection except a few which are half hardy.

Gerhardi, William Alexander (b. 1893) English novelist was born in Russia where he has served in the English diplomatic corps. His works include *The Polyglots* (1907), *Short Story* (1907), *Jack and Jasper* (1928), *Pending Heaven* (1930) and *The Memoirs of Sir John* (with B. A. Lunn).

Gerhardt, Charles Frédéric (1816-1886) French chemist. He studied chemistry in Germany going finally to Giessen where he became one of the many famous chemists trained by Liebig. He moved to Paris and after staying there for some years became Professor of Chemistry at Montpellier transferring to Strasbourg in 1853 just before his death. Gerhardt's principal contribution to chemistry was made in collaboration with Laurent (qv) with whom he put forward the type

theory of chemical compounds. This although later known to be erroneous had at the time a very stimulating effect on the development of organic chemistry. Also with Laurent he helped to clarify the then confused chemical nomenclature by distinguishing between the terms *molecule*, *atom* and *equivalent*.

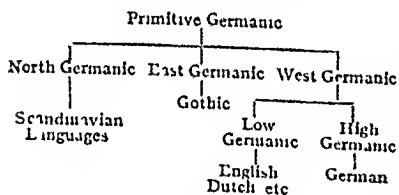
Gerhardt, Elena (b. 1883) German singer of *Lied* born at Leipzig. She first appeared in London in 1900 since when she has enjoyed an unrivalled popularity as an interpreter of the songs of Schubert, Brahms and Wolf.

German, Sir Edward (b. 1880) English musical composer. He studied at the Royal Academy of Music and became musical director at the Globe Theatre in 1888 producing the incidental music to *Richard III* in 1889. This established his reputation which was considerably enhanced by his music to *Henry VIII* in 1897. Among his other musical works are the completion of Sullivan's unfinished opera *The Emerald Isle* (1901), *Merrie England* (1902), *The Princess of Kensington* (1903), *Ton Joies* (1904), *Nell Gwynn* (1900), *The Just So Song Book* (with Kipling) (1904) and *The Willow Song* (*Othello*) performed at the centenary of the Royal Academy of Music 1909. He has also written orchestral music and songs. His work is scholarly but melodious somewhat reminiscent of that of Sullivan.

Germanic League the league of the smaller German States and the Free Cities constituted at the Congress of Vienna (qv) in 1815.

Germanic or Teutonic Languages. One of the main branches of the Indo-European (qv) family of languages. They are classified as follows. **Low Germanic** represented by the extinct Gothic, **North Germanic** from which Icelandic, Danish, Norwegian and Swedish are descended, and **West Germanic**. The last is again subdivided into Low German and High German. English, Dutch, Flemish, Frisian are among the Low German

languages, and High German has its sole representative in modern German. All these languages are closely related to each other, being differentiated from the other Indo-European languages by the following characteristics: (1) two great consonant shifts, the first of which affected them all, and the second placing High German in a class by itself (*see* GRIMM'S LAW). (2) The fixing of the accent on the first syllable of the word. (3) Certain peculiarities of declension and conjugation, for example, the strong and weak declension of adjectives which survives in German. From a consideration of Grimm's Law, it will be seen that German is distinct from all the other Germanic languages, as being the result of a later consonant shift which did not affect the other. This in itself is enough to dispose of the popular idea (if it still exists) that English is "derived" from German. It would be more correct to say that German stands to English in the relation of a junior first cousin. The historical relationship may be shown diagrammatically as follows:



Germanium. For the characteristics of germanium *see* ELEMENTS

One of the rarer metallic elements, it is found in ores, but the germanium used commercially is obtained from the residue of zinc refining.

Germanium is a brittle metal, chemically resembling silicon. This resemblance is especially noticeable in the power of germanium to form organo-metallic compounds, such as germinoehloroform, GeHCl_3 , which resemble the corresponding silicon and carbon compounds.

Germanium is utilised in radio-engineering for the manufacture of

high resistances, and medicinally the dioxide has been employed in the treatment of anaemia.

German Language. There are actually several W. Germanic languages or dialects which are known simply as "German", and these are broadly divided into Low German and High German. The Low German languages which include Saxon and Westphalian and (though these are not generally called German) Flemish and Dutch and Frisian, are distinguished from High German by the fact that they have not experienced the consonant shift (*see* GRIMM'S LAW) which characterises High German. The Low German languages, such as Flemish or Anglo-Saxon, are therefore not so far removed from the primitive Germanic as are the High German.

But the term German is usually understood as referring to the standard High German speech of Germany, and need be only so considered here. Three historical periods of this language are recognised: *Old High German* (up to c. 1050), *Middle High German* (the final date of which has been variously placed at c. 1250 and c. 1600), and *Modern High German*. The changes which have occurred in the language during these three periods are like those which have taken place in other languages, that is to say, certain unstressed vowels gradually lost their character and became -e, and certain of the more complicated grammatical inflexions disappeared. German has preserved more of the old grammatical machinery than has any other Germanic tongue, but whereas the Old High German noun had 6 cases, modern German has only 4. The following are the salient characteristics of modern German grammar.

The three grammatical genders (masculine, feminine, and neuter) are preserved. Nouns form their plurals in various ways, which are a stumbling-block to the foreign learner: some add -s, some -en, some -er, some do not change at all; some form their plurals by the mutation (*Umlaut*) of the

accented vowel with or without one or other of the above plural endings but it is noteworthy that not a single true German noun forms its plural with the ending *s* or *es*. The declension of adjectives is peculiar as may be seen from the following variants of the nominative singular masculine *guter Wein* (good wine) *der gute Wein* (the good wine) and *der Wein ist gut* (the wine is good). The conjugation of verbs is very similar to that of English that is there are strong and weak verbs (compare *singen sang gesungen* with *lieben liebte geliebt*). But in German the personal endings of the present and imperfect are more perfectly preserved than in English and the past participle has kept the prefix *ge* which English once had but has now lost. Another peculiarity of the German verb is the tremendous change of meaning that it can undergo when compounded with various prepositions *fangen* means to catch *anfassen* to begin (to catch on). Again the preposition with which a verb is compounded becomes in very many constructions separated from the verb thus *ich werde anfangen* I shall begin but *ich fange an* I began.

Phonetics. One of the most noticeable features of German pronunciation is the prevalence of the glottal stop (which is really a sort of weak cough) before an initial vowel sound. The German makes an appreciable break for example between the words *erst* and *zwei* and few things are so offensive to our ears as to hear a foreigner pronouncing these words with a strong liaison between the *r* and the *s*. *Ch* represents two distinct sounds the *ack* (the sound in the Scots *loch*) when it occurs after the vowel *a* *o* *u* and *u* and the *ich-laut* (like English *h*) out with the tongue pressed against the upper teeth ridge when it occurs after other vowel sounds. *Sp* and *st* at the beginning of a syllable are pronounced *shp* and *stt* nasal *b* *d* *g* become *p* *t* *k* *w* pronounced like English *v* and *v* like *f*. Except in

stage German *r* is in certain positions no more rolled than it is in English. *Z* is pronounced *ds*. The vowel sounds are very much purer and more vigorous than the *e* of English and many of them have both rounded and unrounded varieties (see PHONETICS). It may be of use to those entirely unacquainted with the language to point out that *au* is *ou* *ei* and *a* *i* *ie* *ä* and *iu* or *a* *ä* *oe* and *o* roughly *e* *u* as in French *tu*. In general a strong characteristic of German speech is the very marked stress given to accented syllables and the rapid slurring over of unstressed syllables. The accent except for a few unstressed prefixes and in foreign words falls on the first syllable.

Word Order. This is governed by somewhat complicated but very rigid rules the chief of which are as follows. In a simple sentence the verb must occupy the second syntactical position thus *My uncle dined yesterday*. But if the subject is not put first in the sentence this rule still holds good thus *t* is incorrect in German to say *Yesterday my uncle dined* the order must be *Yesterday dined my uncle*. Again the rule is that in all subordinate clauses the verb must come last thus *After my uncle the bill saw wished he that he not dined had*. When owing to an agglomeration of auxiliaries several verbs come together at the end of a clause or sentence the order of the *e* is just the reverse of the English order thus *When the waiter my uncle was seawered t e that he not paid he well*.

Vocabulary and Word Formation. Though the German language is predominantly composed of words of native origin it has like every other language borrowed quite largely from other languages. It owes many of its words taken from Latin and Greek have especially contributed to the German scientific and literary vocabulary. Many words have been borrowed from French at various periods particularly during the time of Frederick the Great and at the

French Revolution Among other languages to which German is indebted, English has supplied many words connected with sport. A noticeable feature of German is its method of forming words by joining two or more words into one compound thus "second-hand bookshop" (which even in English partially illustrates the same method) is in German *Antiquariatsbuchhandlung*, with no hyphen.

German was until recently both written and printed exclusively in the Gothic character. Now both this and the Latin character are used, and the latter is steadily supplanting the former, but one of the Gothic letters holds its place—*sz* is written and printed *ß*.

German Literature Apart from the translation into Gothic of parts of the New Testament by Bishop Ulfilas (c 350), German literature can be considered as non-existent until the reign of Charlemagne, and even then, the ecclesiastical dominance had such a hold on writers that little of literary value emerged during the Old High German period (up to 1050). The prose, religious in tone, of Notker Labeo (d 1022) shows the beginnings of a sense of style, but the only work worthy of mention is the epic *Hildebrandslied* (c 800). In the Middle High German period (1050-1350) religious prose and poetry continues, but new influences, mysticism, chivalry, begin to be noticed. The *Spilleute* or minstrels sang of the deeds of ancient heroes, and, after 1150, the Crusades and the crusading knights become the subject-matter of popular ballads and epics. Based on the old sagas, with the addition of French influences, the Court Epic (*Hofepos*) makes its appearance, of which there were four great masters, Heinrich von Veldke, Hartmann von Aue, Wolfram von Eschenbach, and Gottfried von Strassburg, their best-known works are *Enie*, *Erec der Wunderaere* (an Arthurian epic), *Parzival*, and *Tristan* respectively. Developing from the *Hofepos*, the *Volksepos* (National Epic) took its

stories from historical events and from early German legends. Of these the *Nibelungenlied* and *Gudrun* are the most famous examples.

But perhaps the most interesting literary development of this period was the *Minnesang*. The *minnesingers* were imitators of the troubadours, their poetry was lyrical and erotic. The verse of Walther von der Vogelweide (b c 1168) in style and form remained unsurpassed until Goethe's lyrics were written. Towards the end of this period, poetry began to decline into satire and parody. The Transition Period (1350-1600) saw the rise of a poetry that voiced the feelings of the *burger* or merchant class. It became more secular, *Minnesang* gave way to *Meistersang*, the place of the court was taken by the guilds. Each of these "trade unions" had a musical society attached to it, and competitions for verse and song were held, the *Meistersingers*, of whom the greatest was Hans Sachs, based their verse, however, on religious subjects, and the true lyric poetry developed into the *Volkshied* (folk-songs, simple hymns and ballads, tales, in prose and verse, of familiar heroes, and moral verse in abundance).

Until now prose had played an unimportant part in German literature, and the drama had been written mostly in Latin, in imitation of Terence, Plautus, and Seneca. But in the 16th cent both prose and drama began to develop, the former was the vehicle for numerous romances, based on old Court epics or on French originals, while the latter developed a religious tone, and *mystery plays*, based on stories from the Bible (e.g. the *Play of the Ten Virgins*, 1322), became popular. Satire also came into prominence with *Ill Lulenspiegel* and Sebastian Brandt's *Narrenschiff* (Ship of Fools).

The invention of printing had its first important result in the wide dissemination of the anti-Catholic propaganda that preceded, and the numerous Protestant works, led by Luther's Bible, that followed, the Reformation. The Bible of Luther, apart from its

theological importance was of the utmost value to German literature for it set the standard of a recognised German literary language. The 16th cent. however made little other contribution to German literature and is chiefly noteworthy for the influence on drama of the English actors who visited Germany after 1500 bringing with them something of the vitality of the Elizabethan drama.

The 17th cent. showed little advance: prose was confined to translations of foreign especially Spanish romances and picaresque novels; poetry was in the hands of theorists who wrote learnedly about its objects but produced little real verse of any value and drama consisted of fantastic tragedy imitated from foreign countries especially from Holland and comedy which is humorous only when read in its original local dialects. Among the few names of this century worthy of mention are those of Martin Opitz (1624-1639) the theorist who wrote a *Büchlein von der deutschen Poeterei* (1624); Simon Dach and Paul Fleming who subordinating practice to theory allowed the rules of Opitz to devalue their own lyrical sense; Paul Gerhardt a writer of hymns which reflect the stress of the Thirty Years War (1618-48); von Grimmelshausen (1624-69) the author of the first German novel *Simplicissimus* (1669); and von Hofmannswaldau (1611-1679) who practised a kind of German enthusiasm. The publication of *Nebenstunden Unterschied der Gedichte* (1600) by von Canitz (1654-1693) by its style and a sense of true elegance foreshadowed the developments of the 18th cent.

The early 18th cent. however was marked by no signs of progress. Frederick William of Prussia the friend and devotee of Voltaire was more interested in French than in German culture and the French language habits of thought and literary forms for a time completely ousted native literature. But gradually a process of 'cleaning-up' took place the

useless elements of German letters were swept away the fresh rationalist influences of English letters began to be felt and the disputes between the Zurich and Leipzig schools cleared the air of the bombastic decadence of the neo-classical writers. This period of *Aufklärung* as it is called culminated in the publication of the first three cantos of the *Messias* (1748) by Friedrich Klopstock the first of the giants of the classical German literature of the second half of the 18th cent. The *Messias* was an epic in 60 cantos which with its new magnificence of diction and metre and its lyrical beauty effected a revolution in German poetry. Other influences at work were the discovery of Shakespeare by Wieland and of Bishop Percy's *Reliques* by Bürger who also recreated the ballad with his famous *Lenore* (1773) and the translations of the *Iliad* and the *Odyssey* by members of the Göttinger Bund (Voss Gessner and the Stollberg). The rationalism of Leibnitz and the true Hellenism of Wieland were combined by Lessing (1729-1815) whose *Ladon* (1766) and *Hamburgische Dramaturgie* (1769) in theory and *Minna von Barnhelm* (1767) in practice were the pioneer works in the dramatic field of the new period. He with Herder (1744-1803) who supplied the patriotic element laid the foundation of the *Sturm und Drang* movement that fostered the genius of Goethe Schiller and the Schlegels and dominated German letters until 1807. This revolutionary movement was the form which the romantic revival took in Germany but the greatest of German dramatists Goethe and Schiller quickly outgrew its temporary extravaganza. The *Faust*, *Edmond* and *Torquato* Tasso of Goethe and the *Huani in Die Ju* 'au von Orleans' and *Walden* of Schiller are the greatest of German dramas occupying like Shakespeare a place of their own.

This new awakening included a so-called men as Jean Paul Richter the

brothers Schlegel and Grimm, Uhland, Tieck, Novalis, Kleist, Arndt, Chamisso, Liehendorff, Arnim, and Brentano. After 1813, however, the Romantic movement began to decline, as witness the cynical and decadent works of Immermann, Hoffman, and Werner, and the French Revolution of 1830 finally destroyed it. From then until 1848, when revolutions broke out in Berlin and Vienna, the spark of discontent was fanned by the *Young Germans*, Wienbarg, Borne, Mundt, Laube, and, above all, Heine (1797-1856). Their works were suppressed by the reactionary Governments, under the direction of Metternich, but no authority could suppress the growing under-current of revolution.

After 1848, in Germany, as throughout Europe, the novel became, with the social drama, the chief literary vehicle of Realism. At first the influence of Scott moulded the historical novel, but Freytag (1816-1895) showed that the study of contemporary society was an excellent basis for novel and comedy. Auerbach, Bitzian, and Reuter were other masterly painters of peasant life, while the "problem" play was the genre of Hebbel (1813-1863). Gottfried Keller (*Der grüne Heinrich*), Meyer, Theodor Storm, and Fontane were early writers of realist novels and short stories, and, under the influences of Zola, Ibsen, and the Russian novelists, the movement reached its climax in the Socialist dramas of Hauptmann and Sudermann. But realism degenerated into the merely sordid dissection of the abnormal, and a new *symbolist* movement, led by Stefan George and Rilke, grew up which, placing art and beauty above truth, quickly faded into a decadent aestheticism. The World War caused a crop of patriotic poems, plays, and novels, which was soon submerged beneath a heap of revolutionary and satirical works. Heinrich and Thomas Mann, Remarque, Toller, Arnold and Stefan Zweig, Wassermann, Feuchtwanger and von Unruh are

post-War writers whose names have become familiar throughout Europe.

An intensely introspective nationalism, which rigorously excludes every influence and tendency that is not deeply rooted in German soil, appears likely to become an irresistible force dominating the whole of German culture. It may be that this will lead to a period of vital and vigorous literary creation, or it may, on the other hand, prove that the native resources of the German character, deprived of the leaven of foreign contact and influence, will drag the literature down to an uninspired mediocrity.

German Silver, an alloy (qv) consisting of 50 per cent of copper, together with zinc and nickel, the proportions of the last two metals vary somewhat in different makes of alloy, but are usually approximately equal (i.e. 25 per cent of each).

Germany, a European republic since 1918, bounded N by the Baltic Sea and Jutland, N.W. and W by the North Sea, Holland, Belgium, Luxembourg and France, S by Switzerland, Austria, and Czechoslovakia, and E by Poland. E Prussia is entirely cut off from the rest of Germany by the Polish Corridor (qv), and is bounded by Poland and Lithuania. Area (excluding the Saar) 180,985 sq. m., pop. (1933) 65,335,879. Stretching inland from the North and Baltic Seas is a wide plain. The Alps extend right across the S, while in between are the valley of the Danube and the basin of the Neckar and the Main, cut off from the N plain by a belt of high land. The valley of the Rhine runs almost due N and S along the E border, taking a sharp turn E to enter Holland. Between Basle and Mainz this valley is very deep, the highlands known as the Schwarzwald forming the eastern edge. There are a few islands belonging to Germany in the North and Baltic Seas.

Chief rivers are the Rhine, Danube, Elbe, Vistula and Oder, and these, with smaller rivers, form important internal communications. In all parts

considerable forest areas exist except in the N W In S areas such fruits as figs apricots and peaches can be grown Vines grow along the Rhine and Danube in favourable situations Large crops of potatoes sugar beet flax hops rye buckwheat maize and other cereals are obtained

Government The present form of Germany was decided by the Weimar Constitution of 1919 and it is made up of the following 17 States Prussia Bavaria Saxony Hesse Baden Anhalt Schaumburg Lippe Thuringia Brunswick Lippe Württemberg Oldenburg Mecklenburg Strelitz Mecklenburg Schwerin Hamburg Bremen and Lubeck

The Saar Territory at present governed by a Commission of the



View of railway Hubing first part of Germany and the third largest in the world

League of Nations is to decide by plebiscite in 1935 whether it will adhere to France or Germany or become independent of both Government is by a President who appoints a Chancellor and ministers who are responsible for the government The Reichstag or Council elected by vote on proportional representation composed of 661 representatives from the constituent parts of the Republic Under the Weimar Constitution complete freedom of speech the press religion and public meeting were established but this part of the Constitution is no longer operative (1933) The Nat Socialists secured 43 in 1933 votes at the Nov 1933 elections Adolf Hitler is Chancellor and Paul von Hindenburg the President Under the

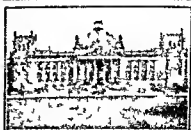
terms of the Versailles Treaty (q.v.) Germany's Army and Navy are severely restricted (1932 100,000 officers and



The coast of the Rhine and the Moselle
Coblenz

men) and compulsory military service abolished No naval or military aircraft are allowed but civil aviation is very highly developed The Navy is a volunteer service restricted to 15,000 officers and men now below strength Small pocket battleships are being developed Germany lost considerable territory by the Treaty including Alsace-Lorraine part of Upper Silesia Losen North Schleswig and all her overseas possessions

Manufactures etc Germany has large resources of iron ore lignite coal and potash Agriculture although government aided is not in a sound financial state The iron and steel



The Reichstag Berlin, seriously damaged by fire April 1933

industry has in the face of great difficulties succeeded in re-establishing itself while machinery chemicals clothing and luxury goods are pro-

duced in vast quantities. The inflation period in Germany, although it brought misery and destitution to thousands, yet had the paradoxical effect of enabling the German bankers and industrialists to bring German industry to an extremely high level of technical efficiency, so that they could flood the world markets with low-priced goods. The output of paper has fallen a little. Industries indicating a definite upward trend are chemicals,



The City Hall, Hamburg, an imposing example of German Renaissance Architecture

automobiles (76 per cent better than 1932), silks, electricity, and wool. In early 1933 exports dropped 18 per cent. Anglo-German trade has been particularly affected by British customs duties.

Unemployment Germany has the highest proportion of workless in Europe. Agricultural unemployment is decreasing, and coal-mining work is being rationed. Special currency in "Employment Treasury Notes" is another experimental move. Since 1870 Germany has had an elaborate system of poor relief administration

Compulsory insurance was introduced in 1883, but contributions are in deficit.

Communications In 1920 the Central Government took control of the various German State railways. In 1921 administration was transferred to the Deutsche Reichsbahn-Gesellschaft, a private company. In 1933 there were 36,010 m of State-owned railway in Germany, forming the world's largest single system, also 2810 m of private rail, 6050 m of light local railways, and a tramway system of 1000 m. Inland waterways in 1931 extend to 7689 m, chiefly rivers, carrying 18,931 ships. Commercial and passenger air traffic is well established. Road surfaces are good and extensive.

Religion and Education. There is no State religion or Church. Protestants are most numerous. Each religious body is allowed freedom in management and conscience. Education is free and compulsory between the ages of 6 and 14. There are graded higher schools, and technical education of high efficiency. There are 23 Universities, noted for one or more branch of study, with more than 100,000 students.

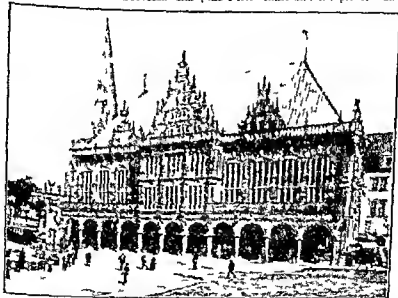
Justice Separate States have their own courts. The *Reichsgericht* (Supreme Court), which sits at Leipzig, has 102 judges attached. Roman law is the basis of the legal system.

History A Roman expedition under Julius Caesar entered Germany in the 1st cent. B.C. Within two centuries many Roman towns had been established along the Rhine and Main, including Cologne, Bonn, Worms, and Augsburg, but successful resistance to Roman penetration was made by the Franks and Alamanni. The Goths and Huns entered Germany from the E. in the 4th and 5th cents. By the end of the 8th cent. Charlemagne had subdued the Saxons, and the whole of the Teutonic area of Germany was subject to him and Christianised. Some 150 years of division and strife followed but in 919, Henry "the Fowler," Duke of Saxony,

ascended the German throne and established order and defence. Otto I his son extended the work and in 961 received the Crown of the Holy Roman Empire (q.v.) from Pope John XII. During his absences in Italy the power of the great lords grew and the feudal system became firmly established. By the 12th cent. violent controversy arose between the Emperor and the Pope. Frederick I Barbarossa Em-

perors on the German throne but the power of the Wittelsbach and Hohenstaufens made these houses almost independent.

Philip of Hesse invited to the papacy inherited in the Reformation its spokesman Luther in 1517 nailed his objections to the sale of indulgences to the door of Wittenberg. Church civil war broke out between the Lutherans and the prince and



Dissension within the Church of the 15th cent. The Emperor is in the foreground.

peror ruled most of his reign in Italy. Frederick II crowned in 1218 held also the crowns of Germany, Burgundy, Lombardy, Sicily, and Jerusalem. The Diet of Mainz 1235 ruled that private war was unlawful thus curbing the power of the princes and nobility. However between 1234 and 1237 there was no king acknowledged by all Germans and the feudal lords became almost independent. The hereditary principle became established.

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-140 saw Habsburg

between the peasants of the South and the prince. In 1320 the grand master of the Teutonic Order of Knights declared the property and lands of the order free from the church and so laid the foundations of Prussia. In 1500 after much intestine warfare the Diet of Augsburg established equality between Catholics and Lutherans but other Christian sects as the Calvinists were excluded. Dissension between Catholic and Protestant led to the Thirty Years War

in 1618, which began with a Protestant revolt in Bohemia. The Treaty of Westphalia, 1648, gave the princes more freedom, although the imperial diet was not abolished.

The economic condition of Germany was now disastrous, agriculture, commerce, and industry alike being practically wiped out. The mouths of all the important German rivers had come under foreign control, and towns had been ruined. Germany, politically, was split up into free cities, principalities, Archbishoprics, countships, without a central authority. In the late 17th cent. France seized much territory, but in the early 18th cent. most of this was regained in the War of the Spanish Succession. From 1756-63 Frederick the Great, King of Prussia, engaged in the barren Seven Years' War, and in 1772 the 1st Partition of Poland increased the area of Prussia. In 1779 Austria abandoned claims on Bavaria and in 1785 the League of German Princes promised a united Germany, but 1806 saw Napoleon establish the Confederation of the Rhine, and the German Empire ceased to exist, the Emperor remaining as Emperor of Austria only. Until 1812 Napoleon was in virtual control, but by 1814 he had fallen and all the land taken by France from Germany since 1702 was restored.

At the Congress of Vienna (1814) Germany was formed into a Confederation of 39 States. In 1848 revolution broke out all over Germany and in Austria, and in 1849 a German constitution was drawn up, following which the King of Prussia was elected Emperor, but refused to accept the post. Reaction set in and all liberal thinkers had to fly abroad, including Karl Marx (*qv*). In 1860, a great popular movement grew up for the unification of Germany, and 2 years later Bismarck took office as Prime Minister of Prussia, with the one ambition of establishing a united Germany. In 1866, the Austro-Prussian War resulted in the formation of the N. German Confederation and,

a year later, the reconstitution of the Zollverein, which included the S. German States.

In 1870 war broke out between France and Prussia, ending in the defeat of France. In 1871 the German Empire came into being with William of Prussia as Emperor. From that date Germany developed steadily, increasing her colonial possessions and becoming one of the great world Powers. William II, who ascended the throne in 1888, dismissed Bismarck 2 years later. From then Germany's growing military and economic power inspired the other great Powers with growing mistrust until, in July 1914, the World War (*qv*) broke out. In 1918 revolution came about in Germany, and the German Republic was set up.

Peace having been signed in 1919, the struggle for a commercial position in the world re-commenced. In July 1920, at the Spa Conference, reparations in kind and disarmament were discussed. Reparations were planned to continue for 60 years. In 1923 the Ruhr was occupied by the French, and the Inter-Allied Commission later reported that hundreds of Germans had been killed and fines of over £20 millions exacted. Stresemann became Foreign Secretary, signing the London Agreements in Aug. 1924, which left Germany free to raise loans for repayments. The Dawes Loan was floated and well subscribed. Two other achievements may be attributed to Stresemann's policy—the Locarno Agreements of 1925 (*qv*), and Germany's entry to the League of Nations in 1926. The French vacated Germany in June 1930.

Nazis in Power Economic and industrial distress in Germany during 1929-31 provided the Nazi Party (*qv*) with an opportunity and their leader with a real chance of power. In April 1932, Hitler challenged Hindenburg for the Presidency, but was narrowly defeated. He demanded the Chancellorship, but this was refused until January 1933.

On Feb. 27, 1933, the Reichstag was

Germany

destroyed by fire. On March 5 a general election resulted in the return of the Nazis with Hitler at their head. The freedom of the press and broadcast was withdrawn, a campaign against Jews, Socialists and Communists commenced, many political opponents were thrown into prison or concentration camps and books by Jewish writers seized and burnt on a large scale. Trade unions were disbanded, political supporters were organised on military (though unarmed) principles and a move against the employment of women begun. By 1933, many thousands of Jews had fled the country, the famous scientist Einstein was out of the country but his property was confiscated. The Jews of the world protested against the treatment of their German brethren.

Germany demanded that the Disarmament Conference at Geneva should either order a general disarmament of all nations or should allow Germany sufficient armaments to train a skeleton army. This request was refused and on Oct. 14 Germany withdrew from the Conference and announced her withdrawal from the League of Nations, asserting she could no longer participate with honour.

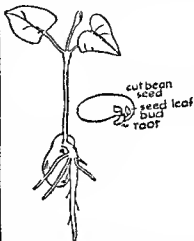
A general election in Nov. 1933 gave an overwhelming vote of confidence in the Nazi party and their policy. The new Reichstag set up was composed almost entirely of Nazis with a few guests.

The Protestant churches have been reorganised into a single German Evangelical Church with Ivan Moller, Nazi military chaplain, as first Primate. Protestant ministers were suspended for resisting interference.

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Germination, the sprouting of seeds into plants, takes place after the seeds have been shed when ripening changes continue. When these are completed the seed remains in a state of rest and germinates immediately the temperature is favourable and water and oxygen are present. The



Germination in bean seed, showing the rudimentary stem and root and all the upward growth of the stem and the downward growth of the root.

first stages of germination may be followed in a bean soaked in tepid water. The seed-coat becomes wrinkled in the neighbourhood of the tiny hole or micropyle situated at one end of the scar of attachment of the seed to the pod. This wrinkling spreads over the whole coat and the seed then swells to about twice its original size and is covered with a perfectly smooth coat or testa. This is due to the fact that the coat absorbs water and expands more quickly than does the seed. When the seed is planted in moist earth the embryo swells and its cells divide.

rapidly, setting up a pressure which forces the point of the embryo root out through the ruptured coat. The stalks of the seed leaves increase in length and carry the bud out of the shell, and the stem grows upwards and the root down. Some seeds will not germinate in the light and a few only when exposed to light, a number require light when the ripening processes are taking place within the seed prior to germination. Seeds live a variable length of time in the dry resting condition, some for one year and some for many years. See also SEED TESTING.

Gérôme, Jean Léon (1824-1904), French painter and sculptor, studied under Delaroche and later travelled to Italy. In 1855 he was awarded the Cross of the Legion d'Honneur, and he was regarded as one of the leading painters of his time. He painted classical subjects, and, after his visit to Turkey and Egypt, Oriental scenes. His best-known work is probably his *Ave, Caesar, morituri te salutamus*.

Gers, département of SW France. Area, 2410 sq m. It is watered by the Adour and tributaries of the Garonne. There are hills and a number of small forests on the S. A considerable area is successfully devoted to agriculture. Viticulture and a flourishing wine trade exist. There are also pottery and flour milling industries. Auch, the capital, is the seat of an archbishop. Pop 196,420.

Gesner, Konrad von (1516-1565), noted Swiss writer and naturalist, was born at Zürich, of German-Swiss descent. He was an erudite scholar and distinguished writer on a great variety of subjects, his principal works being a bibliography of all writers up to his own time, a history of languages, and volumes on the natural history of plants and animals. He was particularly devoted to botany, but most of his MSS on this subject were not published till after his death. He also drew up a scheme of classification of all knowledge.

Gesso [jes'so], Italian for plaster of Paris (qv), more especially when used

as a raised ground for sculpture and painting. It is mixed with water to a smooth paste, then applied to the design with a paint brush. When set it can be coloured with ordinary water colours, then covered with a colourless quick-drying varnish. Gesso can be applied only to a hard surface. Antique furniture of the 18th cent is often decorated with gilt gesso.

Gestalt, see PSYCHOLOGY, COMPARATIVE.

Gesta Romanorum ("Deeds of the Romans"), a collection of tales and anecdotes in Latin dating from the 13th or 14th cent, widely popular, and the ultimate source of many of the plots of Chaucer and Shakespeare among others. The first English translation was printed in c 1512 by Wynkyn de Worde. The romance of *Guy of Warwick*, some part of Chaucer's *Man of Lawes Tale*, and Shakespeare's *King Lear* have their origin in this collection.

Gestation, the period of the development of the young in Mammals up to the time of birth. It varies greatly in duration, partly, but not entirely, in accordance with the condition of the young at birth, and is usually longer in large than in small animals. In the rat, for instance, in which the young are born naked and blind, the period is 3 weeks, in the cat, in which the kittens, although blind and helpless, are covered with hair, it is c 8 weeks. In those monkeys which are about the size of cats, but in which the young are born more advanced in development, it is 7 months, in apes and man it is 9 months. In cattle, in which the calf is well developed and active at birth, the period is 8 months. In horses and asses, in which the foals are born as advanced as calves, the time is c 12 months, in the elephant it is c 20 months.

Gethsemane, a secluded spot on the side of the Mount of Olives, close to Jerusalem, said to be the scene of the Agony in the Garden.

Gettysburg, town, Pennsylvania, U.S.A., the scene of a fierce and decisive battle during the American Civil War (1863), ending in the defeat

of the Confederate forces under General Lee by the Federals led by Meade. It was at Gettysburg during the same year that Lincoln made one of his greatest speeches. Pop. c 4600.

Geyser [GEZE sometimes GIZL] is a natural fountain which spouts a column of steam and hot water at intervals. Geysers are connected with volcanoes and represent a stage when volcanic activity is declining. A geyser consists of a shaft or fissure sufficiently deep to communicate with hot water and vapours beneath the ground. In the lower part of the shaft the temperature is considerably above that at which water boils but the water is kept from boiling by the pressure of the column above whose uppermost layer is in contact with the air is cooled below boiling point. Periodically the surface water is sufficiently heated from beneath to boil the pressure on the layers beneath is relieved and the superheated water changes to steam ejecting the upper whole column of boiling water and steam with great violence. The geyser becomes quiet again until the water again turns to steam. The source of the eruptive action lies in the hot part of the pipe the bottom water being hardly disturbed.

A geyser in the Yellowstone National Park, United States throws up a column of water and steam 200 ft high then follows several weeks of quiet. Another geyser, Old Faithful, throws a column of 150 ft at regular intervals of about an hour. The giant Waimangu geyser of Rotorua, New Zealand used to throw a black column of mud and water to 1100 ft. The terrific pressure finally split the pipe and Waimangu has not been active this century but many smaller geysers play regularly in the surrounding district. There are also extensive thermal regions in Iceland in particular the Geyser Valley and in N.W. of Mt. Hekla containing the Great Geyser and the Strokkir.

The hot water emitted by geysers brings up mineral matter in solution

chiefly silica. With the help of certain algae (q.v.) which can live in water at high temperatures it is deposited as sinter (q.v.) on the ground over which the water flows. When several hot springs issue close together the deposits of sinter may give a variety of coloured terraced aspect to the country as the Rotomahiana pink and white terraces, New Zealand, which were destroyed in an eruption in 1886 and in the Yellowstone Park. Sometimes as the geyser fails and the sinter deposit increases the tube may fill up and leave a friable white column of sinter to mark its site.

The term geyser is also applied to a domestic appliance by which water is heated immediately as required by gas electricity or oil.

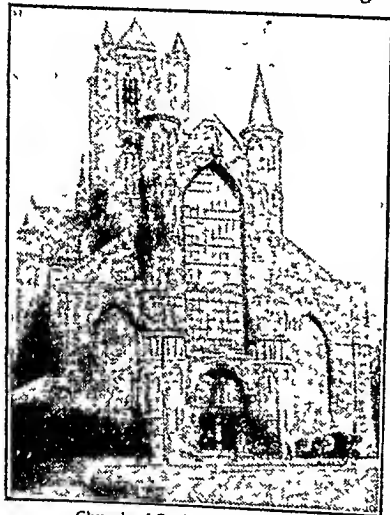
Gharial, often erroneously called Gavial, two species of crocodile-like reptiles distinguished from true crocodiles by their long slender snout by the nasal bones ending some distance from the aperture of the nostrils and by the junction between the two branches of the lower jaw extending a considerable distance towards the back of the mouth. One species is Indian the other occurs in the Malay Peninsula, Borneo and Sumatra. The Indian gharial attains a length of 70 ft and lives in the larger rivers feeding upon fish but rarely attacking man or the larger mammals. The Malayan species is smaller and timid.

Ghats (or *Ghaats*) mountain ranges on the E and W of S India enclosing the Deccan tableland and forming natural barriers of defence. The W Ghats lie close to the coast and afford no exit to the sea for rivers. There are no streams on the Malabar coast. S of the Tapti all rivers flowing E through gaps in the Ghats into the Bay of Bengal. Thus W range averages 3000 ft in height some of the mountains being very precipitous particularly the vast wall of the Sahyadri. On the E side the average height is 1500 ft and these granite and gneiss spurs festoon the Madras coast line down to the Nilgiri hills.

Ghat is a Hindu word meaning landing = stairs or passes. The term is also applied to the flights of steps found on the banks of rivers in India, particularly at Benares.

Ghee (or *ghi*), the clarified butter-fat obtained from buffalo butter. It is widely made in India, where it is used for food and medicinally. See also BUTTER.

Ghent, capital of E Flanders, Belgium, 34 m NW of Brussels, at the confluence of the Lys and Scheldt. It is a city of canals, islands, and bridges.



Church of St. Nicholas, Ghent

The chief industries are cotton, lace, linen, woollen, and paper manufacture, and heavy iron-founding. In 1930 the University became a Flemish University. The Cathedral of St. Bavon and the Hôtel de Ville are important architecturally. Ghent, like Bruges, possesses a Béguinage or nunnery founded in the 13th cent., the inmates of which are employed in lace-making. It was occupied by the Germans from 1914 to 1918. Pop 170,600.

Ghetto, a name of doubtful origin, that part of a city in which Jews were formerly compelled to live, shut off by

gates from the rest of the city. Vienna, Frankfurt, Rome, and Prague were some of the larger cities which had ghettos. Not only were the quarters allocated for the ghetto usually badly situated, but the Jews had to pay a tax for the privilege of living there. The custom did not die out until the mid-19th cent.

Ghibellines, *see* GUELPHS AND GIBELINES.

Ghirlandaio, Domenico (1449-1494), an Italian painter of the Florentine school. His full name was Domenico di Tommaso Curradi di Doffo Bigordi, he acquired the pseudonym of Ghirlandaio from the metal garlands that he manufactured while apprenticed to a goldsmith in his youth. He later worked under Baldovinetti, and in 1480 he was commissioned to paint frescoes in the Church of Ognissanti in Florence, and in the Palazzo Vecchio. In 1481 he went to Rome, where he painted his *Christ calling the first Apostles*, in the Sistine Chapel. His best work is to be seen at Florence; the most famous is *The Birth of the Virgin*, one of the great series of frescoes which he and his assistants executed in the church of S. Maria Novella.

Ghirlandaio did much for the advance of Italian painting, his work is well drawn, solidly modelled, and carefully executed. It is characteristic of his realistic presentation that many portraits of the notables of his time appear in his frescoes. Michelangelo is supposed to have been for a time his pupil. Two of his portraits are in the National Gallery, London. His son, Ridolfo GHIRLANDAIO (1483-1561), was also a painter, and attained considerable fame. His *Coronation of the Virgin* is in the Louvre, and his *Procession to Calvary* in the National Gallery.

Ghurka War (1811-1816), between the British and Gurkhas (Goorkhas), through the encroachments of the latter on British territory. After a series of disasters the Gurkhas were routed, and peace concluded.

Giants, men of enormous size and

power who figure in the folk lore of most countries. The Greek giants are not to be confused with the Titans (*q.v.*) they were the offspring of Heaven and Earth. When the Titans were overthrown by the gods they attacked the giants and piled Mount Ossa upon Pelion in an effort to reach the heavens but they were defeated by the gods with the aid of Hercules. It was supposed in Greek and Hebrew times that the early inhabitants of the earth were giants.

In recent years a man 9 ft 6 in high appeared at the London music halls. Excessive secretion of the pituitary gland (*q.v.*) causes overgrowth of the bones but rarely so excessive as to produce a true giant. Plants commonly described in genetics (*q.v.*) as giant have cells and parts enlarged but show no increased height. They are produced by cells having a multiple of the normal number of chromosomes in the nucleus (*q.v.*) Evening primroses, roses, campanulas, tulips, hyacinths and other plants produce giant forms.

Giants Causeway, a promontory on the Antrim coast N. Ireland peculiar because of its 40,000 beautiful polygonal pillars, hexagonal and pentagonal for the most part. The origin of this basalt collection is attributed to a



Giants Causeway

great lava outpouring during the Tertiary period and to its cooling and cracking. There is a legend that King Olaf intended it as the beginning of a

bridge for giants only to connect Ireland with Scotland. One portion stretches out to sea for nearly 500 ft. Near the Causeway is Spanish Bay where one of the Armada ships foundered.

Gibbon, the smallest and most active of the anthropoid apes (*q.v.*) represented by several distinct kinds ranging in the E. from Assam to Indo-China and Borneo. They excel the other anthropoids in the comparative ease with which they can walk and run on their hind legs and in the speed with which they can traverse the forests swinging from branch to branch by means of their long arms, not leaping like an ordinary monkey. Gibbons are notorious for their vocal powers and clear musical notes. See also ANTHROPOID APES.

Gibbon, Edward (1737-1804) English historian, writer of *The Decline and Fall of the Roman Empire* (1776-88). He passed his youth in wide reading, studying at Oxford and G. in a. His first work was an *Essay sur l'Et d de la Littérature* (1761). He visited Rome in 1764 and there conceived and began his life work. *The Decline and Fall* was very popular and remains one of the greatest histories of all time. It is remarkable for its method, every detail being given its true significance and related to the general trend of events. Gibbon was one of the founders of the modern philosophy of history; the interplay of character and event is welded into an impartial judgment on the general condition of the period. Personal prejudice appears especially in chapters 15 and 16 in which Gibbon attacks Christianity. Here his irony appears to perfection. The style of the *Decline and Fall* is dignified and rhythmical and had much influence on later writers of prose.

Gibbons, Grinling (1648-1709) English wood-carver. Gibbons's origin is obscure; he may have been born in Holland. He was employed by Charles II and worked for some time with Sir Christopher Wren (*q.v.*). His

carving can be seen in the decoration of the choir at St. Paul's Cathedral and in St. George's Chapel Windsor. But



Carving by Grinling Gibbons on Choir Stalls of St. Paul's Cathedral

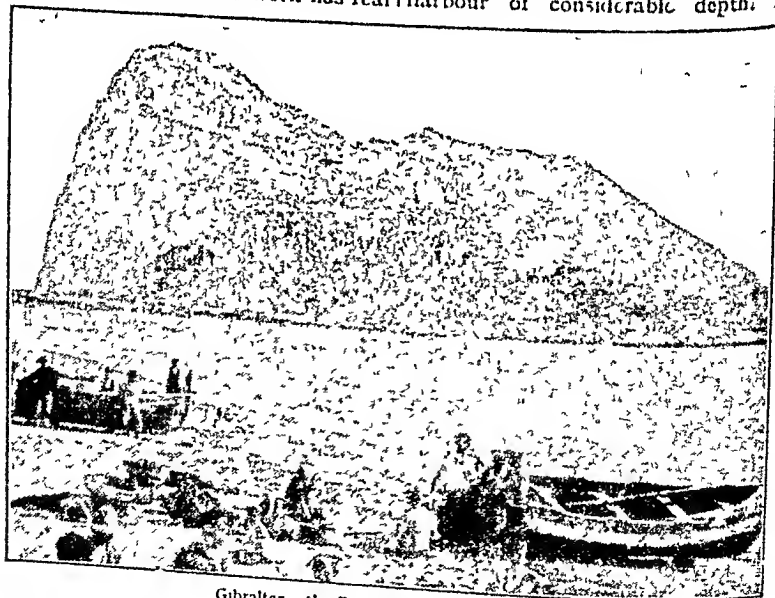
his masterpiece is supposed to be the ceiling that he carved at Petworth. His technical skill may be judged from the fact that he could cut from wood flowers that swayed on their stems in the breeze. Much of his work has real

artistic merit. His bronze life-size statue of James II clad as a Roman emperor is well known, but is not one of his most successful productions.

Gibbons, Orlando (1583-1625), one of the greatest of English composers, was appointed organist at Westminster Abbey in 1623. He composed brilliant polyphonic choral works, and also music for organ and harpsichord.

Gibbs, Sir Philip (b. 1877), English journalist and novelist, World War correspondent. His many novels included *The Street of Adventure*, *The Reckless Lady* (1921), *Young Anarchy* (1926), *The Hidden City* (1930), and *The Inverness Days* (1932). He was knighted in 1920.

Gibraltar, rocky peninsula and British Crown Colony, S. Spain. Area, 11 sq. m. Its industries are unimportant and the trade of the port mainly transit. It is a naval coaling-station. As a naval base it is of great strategic importance, and has an Admiralty harbour of considerable depth. It



Gibraltar the Rock from the Spanish side

was famous in ancient times as one of the Pillars of Hercules, and obtained its name from a Moor who seized the Rock in A.D. 711 and called it Gebel al Tarik after himself. The Spaniards took it in the 15th cent. and Sir George Rooke secured it for England in 1704. It is 1100 ft. high, its harbour can shelter the Mediterranean Fleet and its garrison hold the fortress. The total population civil, naval and military was 21,372 in 1931. Gibraltar is now becoming a tourist centre.

Gibraltar Sieges of (1) War of the Spanish Succession (July 21-23) 1704 the British and Dutch fleets under Sir George Rooke and the Prince of Hesse took the fortress by surprise and captured it after a 2 days' siege. (2-3) In 1704-5 it was unsuccessfully besieged by the Spaniards and French and in 1727 by the Spaniards. (4) June-July 1770-Sept. 3, 1783 the Spaniards and French besieged and blockaded the British garrison but were unable to make any impression.

Gide, André Paul Guillaume (b. 1869) French novelist, dramatist and poet, one of the most powerful influences in 20th-cent. French literature. His works are characterised by acute psychological analysis and an absolute mastery of style. They include *L'Immoraliste* (1902), *La Source Et Océan* (1909), *Les Cahiers du Malin* (1914), *Les Faux Monnayeurs* (1925), *Le Prométhée mal enchaîné* and *Si le Grain ne Meurt* (1934).

Gielgud, John (b. 1904) English actor, member of the Terry family. He was trained at the Lady Benson School and the RADA. He began by walking on at the Old Vic and later became a Shakespearean actor. He is extremely versatile and has appeared with success in *The Cherry Orchard*, *The Seagull*, *Music for Chairs*, *The Good Companions* and *Richard of Bordeaux*. He is also a successful producer.

Gifford, William (1877-1896) English author and editor wrote the *Times* (1914) and *Martins* (1793) in which he bitterly satirised the literature of his

time including drama and especially the Della Cruscan poets. As editor of the *Quarterly Review* (1803-24) he published many attacks on the younger generation of poets and essayists.

Gigli, Beniamino (b. 1891) Italian tenor, the possessor of a voice of great natural beauty and one of the finest exponents of the music of Puccini and Verdi. He succeeded Caruso at the Metropolitan Opera House and sang in London in 1933.

Gila Monster (or *Holodermis*) the only member of the lizard family known to have a venomous bite. The poison is not fatal to man but quickly kills small animals. This lizard is a heavily built inactive reptile 6 in or more in length, has tubercular scales and is banded black and yellow in colour. Although its 4 legs are well developed one of its nearest allies is the common legless blindworm (g.v.).

Gilbert, Sir Alfred (1804-1903) English goldsmith and sculptor was born in London, his father being a musician. He studied in Paris and later in Rome and was greatly influenced by the work of the Italian masters. He was elected A.R.A. in 1837. In 1839 he won the Grand Prix at the International Exhibition in Paris and 3 years later became a full R.A. He resigned the latter distinction in 1869 and resumed his membership only in 1932 the year in which he was knighted. In 1891 he was made a member of the Victorian Order. Gilbert will always be remembered by Londoners as the sculptor of the Shaftesbury Memorial Fountain in Piccadilly and known to them as *Eros*. Among his other works may be mentioned the Westminster statue of Queen Victoria, executed in 1868. Three years after *Eros* his memorial to the Duke of Clarence and his portrait busts of G.F. Watts and Sir George Birdwood. His work as a goldsmith, though naturally less widely known, is considered at least equal to his sculpture.

Gilbert, Sir Humphrey (c. 1639-1583) English navigator and step-brother of Sir Walter Raleigh, was born near

Dartmouth, Devon. In 1586 he petitioned Queen Elizabeth for a patent to discover the N W Passage. He received a charter in 1578, and disposing of all his property left Dartmouth, only to return unsuccessful in 1579. In 1583 he sailed from Plymouth with 5 ships, and after a short voyage landed in Newfoundland, where he established the first English colony in America. On his return to England, his ship, of only 10 tons burden, capsized during a storm, and he was drowned.

Gilbert, Sir John (1817-1897), English painter, was employed as a boy by a London firm of estate-agents. At the age of 19 he exhibited drawings of historical subjects with the Society of British Artists, and from 1838 his drawings and oil-paintings appeared in the Academy. His work was nearly always of a historical character or in illustration of classical literature. His water-colours brought him the widest fame. He became President of the Old Water Colour Society in 1871, and was knighted soon afterwards, he was made an R A in 1870. His work can best be studied at the Guildhall, London.

Gilbert, Sir William Schwenk (1836-1911), English humorist and librettist, collaborator with Sir Arthur Sullivan in the famous comic operas, and at various times a civil servant, a barrister, a captain of the volunteers, and a magistrate. He began to write for *Fun* in 1861, and his contributions were collected into the *Bab Ballads* (1869). *More Bab Ballads* and *Songs of a Savoyard* followed. From 1866 to 1871 he wrote burlesque plays and stories, then met Sir Arthur Sullivan

and wrote comic operas. His libretti are remarkable for their satirical humour expressed in great verbal and metrical felicity.

Gilbert, William (1510-1603), father of the science of magnetism, born at Colchester. He entered John's College, Cambridge (1558), after taking his B A and M A degrees obtained an M.D in 1569. In 1601 became physician to Queen Elizabeth at a salary of £100 a year. He experimented with magnetism, and arrived at the conclusion that the earth was a great magnet. He was first to use the terms "electricity" "electric force," and the first person in England to support Copernicus.

Gilbert and Ellice Islands, archipelagos in the Mid-West Pacific Ocean, extending N. from the Equator. The Ellice, or Lae Islands, most S of the two archipelagos have been British since 1892. Ellice Islands are scattered group of atolls and coral islands, extend more than 300 m and including Funafuti group. The natives, originally Samoans, are mostly Christians. High temperature and abundant rainfall encourage prolific growth. C is exported. Area, 14 sq m, pop. c 1000. The Gilbert Islands, a larger group, were proclaimed a protectorate in 1892, and annexed Great Britain in 1915 at the request of the natives. They lie on the Equator SE of the Marshall Islands. Area 166 sq m, pop. c 30,000. They export copra and phosphate. They are administered by a resident commissioner responsible to the High Commissioner for the Pacific at Fiji.

The Gilbert and Ellice Islands Colony includes several isolated islands.

Stortford. After volunteer service in the Crimea he entered business. He devoted much time to the breeding of horses on which subject he became an acknowledged expert with several standard orks to his credit. He was President of the Royal Agricultural Society in 1895.

Gildas (516?-570) the first British historian. He wrote *De Excidio Britanniae* one of the few sources of information concerning 6th-cent. Britain.

Gilding. Gold lends itself readily to the formation of lustrous coatings on various materials. Electro-plating (*q.v.*) the application of gold leaf (*q.v.*) and the application of the metal in a paint medium are most commonly employed. Rolled gold is a base metal (copper alloy) coated with gold of any required fineness the gold and metal being united by heat when in the form of a thick sheet or bar and then rolled or drawn down to the required thickness the gold coating being reduced in thickness proportionately.

An old process now little used is known as *hot gilding*. For this purpose an amalgam (solution) of gold in mercury is used. The proportion of mercury to gold is c. 10 to 1 and this forms a soft paste. The metal to be gilded is first prepared by amalgamating its surface with mercury by means of a solution of nitrate of mercury. The amalgam is then applied in an oven coat to the metal and the mercury driven off by heat the gold remaining as a dull yellow coating which is further heated. Pottery and glass are gilded by the application of a solution of chloride of gold in a mixture of various oils, one such mixture consisting of oil of lavender and Venetian turpentine.

Recently an old method of producing a coating of gold and other metals has been developed on a very large scale. When certain metals are used as cathodes in a high tension electrical discharge taking place in a high vacuum, the metal is vaporised and thrown down in a coherent and brilliant

form upon a suitably placed surface. This is known as *cathode sputtering*. It was first used by Edison for reproducing his wax phonograph records. The process is now used principally for gilding fabrics but it is also being applied to the production of gramophone records in the manner originally made use of by Edison but abandoned in favour of other methods on account of its expense and difficulty. The records pressed from these gold moulded matrices are freer from surface noise than ordinary records.

The process of gilding was familiar to the ancient Egyptian and it has a continuous history in Persia India and the Far East. Modern gilding is applied to all forms of decoration especially picture frames commercial signs and inscriptions book-covers pottery and china wall paper and ornamental interiors.

Gill Sir David (1843-1914) astronomer born and educated in Aberdeen shire. He was Astronomer Royal at the Cape of Good Hope 1890-1907 and organised expeditions to observe two transits of Venus. In 1885 he commenced a systematic survey of the heavens and by 1898 had published a catalogue of 450,000 stars.

Gill, Eric Rowland (b. 1889) English sculptor and engraver was born at Brighton. In 1899 he was apprenticed to a London architect, a career for which he had no inclination. He earned a living for some years by cutting lettering for tombstones. His first piece of sculpture, a *Madonna and Child* was produced in 1910. In 1913 he became a Roman Catholic and received the commission to carve the Stations of the Cross for Westminster Cathedral. In 1913 he carved the relief of *Christ driving the Money-changers from the Temple* which is placed at the entrance of Leeds University as a war memorial and about the same time produced a second series of Stations of the Cross this time for St. Catherine's, Bradford. He executed the carving on Broad Casting House London.

Gill has written several books on sculpture and æsthetics, and has illustrated a number of finely printed books. He has also done valuable work in the field of type-face designing.

Gillray, James (1757-1815), English caricaturist, said to have been the son of a soldier. He was born in London, and had a somewhat varied early life. Practising engraving at first, he later joined a company of players, and roamed the country for a time before settling down to study at the Royal Academy. He soon gained celebrity for his political cartoons, many of which were directed against George III, including *Farmer George and his Wife*, and *A Connoisseur examining a Cooper*. After the French Revolution he turned his satire against the French, particularly against Napoleon.

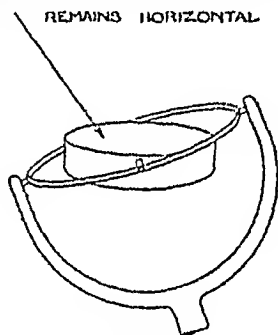
Gills, see CIRCULARORY SYSTEM

Gillyflower, popular name for various flowers, including the pink, carnation, and ragged robin (all of the family Caryophyllaceæ), stock and wallflower (of the family Cruciferae), and also the sea thrift. It is usually applied to the wallflower, though in Chaucer and Elizabethan writers it denoted the pink.

Gilmour, Sir John (b. 1876), British politician. He entered Parliament in 1910, having unsuccessfully contested E. Fife in 1906. He had a distinguished War career, being mentioned in dispatches and awarded the D.S.O. with bar. He succeeded to the baronetcy in 1920, and became a Junior Lord of the Treasury in the following year. He became Secretary of State for Scotland in 1926, in which year he was elected Rector of Edinburgh University, in the National Government of 1931 he became

any inclination of the support to which they are attached. The object is pivoted on two pivots at opposite ends of the diameter of a ring, which itself is pivoted at two points at opposite ends of a diameter at right angles to the first, to a fixed support. The

COMPASS OR OTHER OBJECT SUPPORTED



Gimbals

principle is the same as that of the universal joint (q.v.)

Gimp, has several meanings, all connected with clothing. It is used to describe a thick silk-covered cord used in the crinoline era to trim dresses and also to finish off upholstery. It is also a lace-making term, and is used to describe a certain part of the head-gear of nuns.

Gin, see SPIRITS

Ginger, see SPICES AND CONDIMENTS.

Ginger Beer (Home-made)

- 2 lemons
- 1 lb sugar
- 1 oz yeast
- 1 slice bread
- 1 oz ginger
- 4 quarts boiling water

Cut lemons into thin slices. Add

Gingerbread, *see* CAKE MAKING

Ginkgo a tree from E Asia occasionally found in cultivation belongs



Ginkgo Biloba.

to the same group of Conifers as the yew. It has fan shaped deciduous leaves with a dichotomous cleft. *See also* CONIFERS.

Ginseng the Chinese name for a plant related to though not resembling the ivy found in N China and now cultivated elsewhere for its root which is used for the preparation of a medicine.

Gioconda, La (Mona Lisa) *see* LEONARDO DA VINCI.

Giohetti, Giovanni (1844-1928) Italian statesman. He was Minister of the Treasury in 1889 and Minister of Finance 1890 resigning this position in 1892 to become President of the Ministry. In 1901 he became Minister of the Interior and 2 years later Premier. His pacifist and pro-German sympathies caused his retirement on Italy's entry into the World War. He effected many notable social reforms.

Giordano, Luca (1634-1705) Neapolitan painter a pupil of Ribera. He was renowned while still a youth for the speed with which he worked

and the versatility which enabled him to imitate the paintings of any school. He gained tremendous popularity and in 1697 went to Madrid where he remained at the Court of Charles II for 8 years returning to Naples in 1700 as wealthy as he was famous. His best known work is his *Christ expelling the Traders from the Temple* in the Church of the Padri Girolamini in Naples. A large number of his paintings are in Spain and there is a *Danai and bathsheba* in the National Gallery.

Giorgione [1478-1510] Venetian painter born at Castelfranco. He appears to have been of quite humble origin but little is known of his parentage or of his life. He was apprenticed to Giovanni Bellini and at the age of 22 was already receiving commissions for portraits which included one of the *Doge Agostino Barbarigo*. He was later employed to paint an altarpiece for the Cathedral of Castelfranco and frescoes for the façade of a number of Venetian buildings. When he died of plague about the age of 32 he was one of the most famous painters of his time and widely admired for his powers as a musician his love of life and his personal charm. Not many works remain which can be certainly identified as his. The *Portrait of a Young Man* at Berlin and *The Tempest* in the Palazzo Giovanelli at Venice which has given rise to many fanciful interpretations with the National Gallery *Van in Armour* may be mentioned as outstanding examples of his art. But the works upon which his fame most securely rests are the *Concert* in the Louvre probably one of his last paintings and the Dresden *Sleeping Venus* which was the original on which Titian's renowned *Uffizi Venus* and many others were based.

Giorgione learned the fundaments of his art from his great master but he was probably the first of the Venetians to liberate painting from all traces of primitive formalism and to make new discoveries in realistic

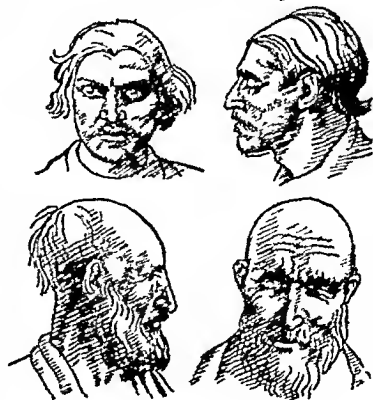
modelling and drawing, in composition, and particularly in richness of colouring, which were eagerly seized upon by Titian and other Venetian painters of the full flower of the Renaissance

Giotto di Bondone (c 1266-c 1336), Italian painter. The date of Giotto's birth is as uncertain as the facts of his early life. He appears to have been the son of a small landholder near Florence and it is probable that in his boyhood he minded his father's sheep, so that the story of Cimabue finding him scratching the portrait of one of them on a stone may be true. The popular belief is that Cimabue took him back to Florence as his assistant and gave him his first training in the art by which he revolutionised Italian painting. Certainly Giotto, by whomsoever taught, liberated Italian art from the formalism and slavery to tradition which it inherited from the Byzantines. In colour, in drawing and modelling, above all in spatial three-dimensional arrangement and solidity of form, Giotto introduced new conceptions and a new reality into the art of painting. His genius was fully recognised and acknowledged in his own lifetime, and he achieved wealth as well as fame, receiving in his old age the crowning distinction of appointment as architect to the cathedral and city of Florence. In this capacity he designed the Campanile, frequently known as "Giotto's tower," which still stands as a beautiful and dignified memorial to his genius.

Much of Giotto's painting has inevitably disappeared, and much has been ruined by ill-judged attempts at restoration, but in the Assisi frescoes illustrating the life of St Francis and in those in the Chapel of the Arena at Padua, his genius is seen at its greatest, scarcely touched by the intervening centuries. The Assisi frescoes consist of four paintings in the Lower Church, the *Beatification of St Francis*, and the allegories of Poverty, Chastity and Obedience, all of which are over the vaulted roof of the tomb of the Saint.

There are a number of other frescoes in the Lower Church, notably a series of 10 illustrating the lives of the Virgin and of Christ, which have been doubtfully attributed to Giotto. His mosaic known as the *Navicella*, of Christ rescuing St Peter from the waves, is still on the inner façade of St. Peter's at Rome, but has been spoilt by restorations. There is a great mosaic altarpiece by Giotto, also in St. Peter's. Sufficient of Giotto's work has survived to justify the fame he enjoyed in his lifetime, and to enable succeeding generations to recognise him as one of the greatest pioneers of European painting and one of the most eminent artists of all time.

Gipsies (or *Gypsies*), wandering folk scattered throughout all European countries, over a good deal of Asia, and part of N Africa. Their origin has been a problem for many years; their speech has now been recognised as a language closely related to some of the N Indian dialects, but such alterations have taken place in both gipsy and Indian languages that no close comparisons can be made. Byzantine writings refer to gypsies, they were certainly in Europe early in the 14th cent., and by 1417 were in Germany. About 1500 they reached



GIPSY TYPES

England described as uncouth black, dirty barbarous who indulge specially in thieving and cheating. Legend said they came from Little Egypt and perpetually wandered to atone for the sin of their forefathers who had shown no mercy to Mary and Joseph when they sought refuge in Egypt but the story is probably confused with that of the Wandering Jew. They very early earned the reputation of fortune telling and thieving the latter due largely to the many tramps, vagrants and outlaws who joined them. Their dirty and fierce appearance and strange tongue frightened European peasants. They were persecuted, tortured and even hanged. As late as 1907 gipsies were persecuted in Germany and fled to England. In different countries their status varies—in Hungary they are the traditional musicians respected and admired in other lands they vary from rich owners of long trains of gaudy caravans and shows of performing animals to the humble tent-dwelling basket maker or old sack collector. All rely

largely on the country folks belief in the occult power of gipsy women whose fortune-telling love-charms selling and card reading often get the palm crossed with silver. Physically they are small dark little snuwy and handsome proportioned. Their number in Europe has been estimated at about a million.

Giraffe the tallest of the Ruminant mammals. It has exceedingly long legs and neck and a short body white and brown spots and short horns permanently covered by hairy skin thus differing from the horns of cattle, sheep and antelopes and from the antlers of deer. There is only one species represented by a few local races found all over Africa S of the Sahara except in the Congo forest. Giraffes feed exclusively on foliage which their great stature enables them to reach at a height of from 10 to 18 ft. or more by using their long tongue for hooking leaves into the mouth. They can reach the ground for drinking only by stretching their fore-legs wide apart. Giraffes have little protection against carnivorous animals except their colouring which is a natural camouflage so that they are hard to distinguish in a forest.

Girdle or Griddle a round metal plate usually of cast iron and 10 in diameter. It has a hinged handle and is used for the cooking of girdles, scones and flapjacks.

Girl Guides see Boy Scouts

Girls' Friendly Society society founded in 1853 with the object of promoting mental, industrial, recreational and religious training. It is open to all girls of good character over the age of 11. Besides out-door activities classes in the domestic arts are organized. A branch was established in the U.S.A. in 1888 and others now exist in all English-speaking countries.

Gironda, coastal department of S.W. France watered by the Garonne and Dordogne and famous for its wines. Bordeaux is the chief town. Area 4100 sq. m. pop. 879,000.

Girondins, Girondists, two ruling



Gipsies with their Caravan

party of moderate Republicans in 1860, 1862 overthrown in 1863. He called himself a member of the "Liberators" and in 1864 the department of Gorton.

Gorton, George (1860-1911) An English writer, born in 1860 at St. Paul's, London. He studied at Cambridge, in 1877. Although members of the Gorton family are not admitted to membership of the University of Cambridge University.

Gish, Lillian (b. 1893) One of the first world-famous film stars. Her first performance has been in D. W. Griffith's *Way Down East* and in Scott's *The Scarlet Letter*. She now appears only on the New York stage.

Gissing, George Robert (1857-1903) English novelist, published his first work, *Workers in the Dawn*, in 1880. His novels are realistic, concerned mostly with the more sordid aspects of London life. They include *The Londoners* (1884), *Demos* (1886), *The House of the Medici* (1887), *New Grub Street* (1891), and *The Woman Traveller* (1911).

Giulio Romano (1492-1546) Italian painter and architect, also known as Giulio di Pietro di Filippo de' Giannuzzi. He belonged to the Roman school, and was a favourite pupil of Raphael. After his master's death he was largely responsible for completing the frescoes in the Sala di Costantino in the Vatican. In 1521 he went to Mantua, where he worked in the service of the Duke Federico Gonzaga, painting his scenes from the Trojan War in the Ducal Palace, rebuilding and decorating the Palazzo del Te, and making extensive alterations to the Cathedral. He also undertook with success the drainage of the surrounding marshes. As a painter he displayed great facility and freedom of style, and his work has won much admiration, although he was a poor colourist. Just before his death, he was offered the post of architect to St. Peter's in Rome. His *Infancy of Jupiter* is in the National Gallery.

Glacial Period, see Ice Ages

Glaciers are rivers of ice arising from

compression of the snow which covers the earth's surface at high altitudes. The centre of the glacier moves faster than the edges. The rate of movement of glaciers varies considerably under different conditions. A glacier's flow is retarded by the weight of the ice which it carries, and by the friction of the ice against the rocks which it moves over. The centre and surface move faster than the edges, and can be moved by plowing a line of rocks across the glacier. Melting, by producing a thin layer of water, also retards the flow. The pressure against the obstacles holding the ice which it carries causes it to melt of pressure when the obstacle



Tyng Glacier and Lake, Norway

has been passed. Glaciers move very slowly.

The Mer de Glace in Switzerland, moves in the centre at c. 1 m. an hour in the summer, but only half as fast in the winter, since while heat facilitates the flow of a glacier, cold retards it. In Greenland some glaciers move 80 ft. in a day. Glaciers often are of considerable size. In the Alps they may be 1000 ft. thick averaging c. 5 m. in length. In Greenland, the Himalayas, and the Antarctic, they are much longer, the Antarctic Beardmore Glacier being 200 m. in length.

Where a stationary snow or ice-field gives rise to a moving glacier a semi-circular crack or *Bergschrund* develops in summer between them owing to the decrease in snowfall diminishing the supply of ice. This crack admits rain or thaw water and in the opinion of those who consider water a greater erosive agent than ice promotes greater erosion at the head of the glacier than elsewhere. Steep crags therefore are often found at the heads of glaciers while much material is provided to be carried away. This material as the glacier descends the valley is augmented by stones rocks and soil which fall from the sides and form heaps called *lateral moraine* along each side of the ice. When two glaciers meet from convergent valleys the lateral moraines on one side of each coalesce to form a *medan moraine*.

Glaciers exert an influence on the surface features of the earth both by transporting moraine material and by eroding and polishing the rocks they pass over. Moraine material falling down crevasses becomes wedged in the ice and angular stones are dragged over the bed rock forming large quantities of powdered sand and clay which are carried along the glacier bed as the *ground* or *bottom moraine*. Boulder clay (*gl till*) is commonly formed in this way.

Should the climate become warmer glaciers will retreat or melt away at their lower end and the rocks on the valley floor thus exposed show characteristic grooves and scratches in the direction of movement of the glacier due to the stones dragged over them. The polished and rounded rocks often resemble the backs of soap and hence they are termed *roches lustrées*. The abrasive stones are themselves smoothed and scratched. Glaciers transport quite large masses of rock called *erratics* (*gl err*) for long distances, and deposit them when melting. At the end of the glacier the ground moraine forms a ridge of boulder clay which is called a *terminal moraine* several of which in one valley mark

ing stages in retreat of the glacier. In polar regions glaciers reach the sea and give rise to ice bergs.

The extent to which a glacier itself denudes or merely modifies the effects of water erosion is under dispute the evidence being capable of interpretation to support either theory. But there is no doubt that a glacier does modify a V shaped water cut valley so that it takes on a wide U shape in section and a landscape which has been under the influence of glaciation shows valleys of this shape and rounded dome like hills. See also MOUNTAIN-ENGINEERING.

Gladiators professional fighting men of ancient Rome who fought in single combat for public entertainment. It is supposed that gladiatorial shows were borrowed from the Etruscans the first exhibition in Rome being given in 64 B.C. The practice was prohibited by Constantine in A.D. 313 but continued until suppressed in A.D. 400. Gladiators were normally slaves criminals or prisoners and fought with sword and shield with net and trident or with short swords and buckler. The fate of the defeated combatant was decided by the gestures of the spectators if they waved his life to be spared they waved their handkerchiefs if they desired his death they turned their thumbs downwards. Well born warriors occasionally fought in the arena and also women divas horsemen and charoteers. Successful gladiators were often given their freedom and were regarded as public heroes.

Gladiolus (*Corn Flag* *Sword Lily*) half hardy bulbous plants of the family Iridaceae having long sword shaped leaves with often a reddish tinge at the base and large and handsome flowers borne in a one-sided spike on an erect stem some 18 in. high. The bulbs are planted in April in sunny well-drained rich soil 4 in. deep and 6 in. apart. The spikes are tied to sticks when 3 in. high and fed with liquid manure when the flower buds form. The bulbs are lifted in Nov. and stored in an airy dry place safe

from frost Scarlet, crimson, rose, white, yellow, and purple varieties are grown

Gladstone, Wm. Ewart (1809-1898), English statesman Entered Parliament as Conservative member for Newark, 1832, and in 1834 became Junior Lord of the Treasury in Peel's administration, and the following year Under-Secretary for War and Colonies In Peel's second administration he was Vice-President of the Board of Trade, later becoming President In Feb 1845 resigned when Parliament



William Ewart Gladstone

made a grant to Maynooth (Irish RC) College, but in Dec succeeded Lord Stanley as Colonial Secretary Palmerston's Greek policy of 1850 was strongly criticised by him, and his attack on Disraeli's budget during Lord Derby's administration resulted in the fall of the Government (1862) He became Chancellor of the Exchequer in the subsequent Coalition Cabinet (Dec 1862), and again from 1859 to 1866 under Palmerston, and from 1873-4 and 1880-2

During these terms of office as Chancellor of the Exchequer, when he threw himself into the task of reducing taxation and promoting free trade, his capabilities were afforded great scope, and were revealed to the nation in a series of brilliant budget speeches He achieved ever-increasing reductions in income tax and excise duties, and won great popularity in the country In 1866 his introduction of his first Reform Bill caused the defeat of the Government, and effected amendments on Disraeli's Reform Bill, which was introduced by the new administration The following year he succeeded Lord John Russell as head of the Liberal

Party, and in 1868, after his resolutions regarding the disestablishment of the Irish Church had been carried, and the Government later had been defeated, he returned to the House as Prime Minister The disestablishment of the Irish Church was accomplished, the first Irish Land Bill of 1870 and the University Test Bill of 1871 were passed, and the American claims over the *Alabama* were settled

But with the General Election of 1874 the Tories again came into power, Gladstone resigned his leadership of the Liberals and retired. Soon, however, he was wholeheartedly condemning the Government's foreign, particularly its Turkish and Afghan policy, and by 1879 he had embarked on the memorable campaign in Midlothian, which resulted in the Queen having reluctantly to send for him once again in 1880 Notable events of this administration were the passing of the Irish Coercion Bill in 1881, the outlining of S. African policy following on the Majuba Hill defeat, and the fatal delay of the Government in sending help to Gordon at Khartoum The budget of 1885 caused his resignation, but after the defeat of the Conservatives in 1886 he began his third term as Premier, which was ended in the same year by the defeat of the Home Rule Bill In 1892 he began his fourth and last administration, introducing another Home Rule Bill which was passed by the House of Commons, but rejected by the House of Lords He resigned finally in 1894, and died at Hawarden in 1898, having achieved a stature as orator and statesman unrivalled in his lifetime

Gladstone was a life-long student of classical literature, and he was regarded as an authority on Homer He translated the Odes of Horace, and, after his retirement, engrossed himself in the study of theology

Glamorganshire, S.E. county of Wales, bounded N.W. by Carmarthenshire, N. by Brecon, E. by Monmouthshire, and S. by the Bristol Channel Formerly a stretch of beautiful mountains and valleys, the industrial

development of the 19th cent has spoiled all but the Vale of Glamorgan coal underlying almost the whole of the surface. The whole country depends on coal and the iron and steel and kindred industries which grew up as a result of the development of the fuel resources. The Rhondda Valley produces excellent steam coal while anthracite is mined round Swansea. The coast has an almost continuous line of ports, including Cardiff (the county town) and Swansea.

Agriculture is confined to the coastal plain between Caerphilly and Margam while some sheep and ponies are raised in the mountains. Area 810 sq m pop (1931) 1,571.

Glanders, a disease (acute or chronic) attacking horses due to a bacillus (*Bacillus mallei*) which affects their lungs and sometimes the membrane of the nose and throat. It is communicable to man by contagion generally through an abrasion and is often developed by grooms and cavalry soldiers. Glanders which first attacks the lymphatic glands is called *farcy*. Several days after infection swelling and inflammation appear either round the point of infection or in the nose and abscesses or ulcers form. The disease is usually fatal through its general effect pneumonia supervening. The treatment is excision of the original area of infection opening of abscesses, and maintenance of the strength of the patient.

Glands. This word is so frequently and so loosely used that it often misleads us by implying many things that are not strictly correct. There are several distinct types of structures in the body which are now known by the name of glands although originally only one of these types was so designated. The word was first used to describe those structures in the body which manufacture complex fluids by a process called secretion and expel these fluids through a duct or ducts on to the surface either of the skin or the mucous membrane of the alimentary canal. Examples of these are the

salivary glands which pour saliva into the mouth and the sweat glands which pour droplets of perspiration on to the skin.

Not so many years ago it was believed that there were also gland-like structures in the body which have no ducts leading to a surface but which get rid of their secretions by discharging them into the blood stream. These were called ductless glands and their secretions became known as hormones. Thirdly there are structures exemplified by what are popularly known as glands in the neck, which so far as is known at present have no pretensions to the name of gland at all. They do not produce any known secretion and their main function seems to be to act as filters for lymph for which purpose they are situated at intervals along the channels of the lymphatic system (qv) and furthermore they are fully occupied in that they constitute busy centres for the formation of one type of white blood corpuscle (*see* Blood).

The exact rôle of each of these types of gland is described under DIGESTIVE SYSTEM, ENDOCRINE SYSTEM and LYMPHATIC SYSTEM but for the sake of comparison further details of each type will be given here.

The orthodox type of gland which pours its secretion on to the skin and mucous membranes in its simplest form takes the shape of a tubular depression in the surface of the skin as shown in Fig I. This is in fact the way in which it is formed in the embryo. The cells which form the lining of the cylinder are the same in origin as those which form the surface of the skin but they become modified in shape and specially adapted to secretion. These secreting cells may be either distributed throughout the tube or gland or limited to the lower part.

The next and more complicated type of gland is the branched tubular as shown in Fig II. In this case most of the secreting is done by the cells lining the branches and the main stem

is beginning to take on the function of a duct. In addition to this, whether the gland be branched or single, the ends may become coiled, a feature very well seen in the case of the sweat glands of the skin (Fig III).

The cells which carry out the secreting functions are not necessarily all of the same type, some may secrete one substance, and others, another. A gland which secretes two types of substance is called a mixed gland (Fig IV).

Some glands become further elaborated by a process of repeated branching, and in this case the connecting duct may be compared to a tree with many branches, and the secreting portions at the ends of the branches are, as it were, the "leaves" (Fig V). When glands become as big as this, they are bound into a compact unit by the development of fibrous tissue, which forms a capsule, and sends down partitions to divide off and support the various ramifications of the glands.

Simple glands, as shown in Figs I and II, are exemplified by the sebaceous or grease glands in the skin, the glands in the walls of the alimentary tract, and those in the wall of the uterus, while the compound glands just described are exemplified by the salivary glands, which discharge salivary juices into the mouth, the liver, which discharges its secretion through a single duct into the intestine, and the pancreas, which is formed by the fusion of two glands, and has two ducts, both of which lead also into the intestine. The mammary gland is also of this type.

The structures of the other type of glands which have no ducts, and which produce hormones, vary considerably, for not only do these glands arise in great variety of different tissues, but they are also complicated by the fact that in some cases they constitute a double gland which produces two kinds of hormone, and in others they form part of a gland which has a duct, although they do not use the

duct. For example, the suprarenal glands produce adrenalin as well as probably a second hormone, and the pancreas produces digestive juices, which are discharged into the intestine, as well as insulin, which is discharged independently into the blood. The factor common to all these ductless glands is their rich supply of blood-vessels—and this is not surprising, in view of the essential part played by the blood in carrying away the secretions formed.

In the pancreas and the suprarenal glands the secreting cells are gathered together in a compact manner, forming cell nests in the former (Fig VI), and a complete cell layer in the latter. But in the thyroid gland, which is situated in the mid-line of the neck, and produces the hormone known as thyroxin, the secreting cells form the linings of lobules (Fig VII) into the centre of which they pour their products. These lobules act as storage places where the thyroxin can remain until wanted by the body.

In both these gland-types the secretion of their products is dependent upon the arrival of an adequate stimulation, which may take the form of nervous impulses or of biochemical substances, which latter may themselves be hormones derived from another gland. Besides stimulating production, these influences also stimulate liberation of the secretion when it has been formed. In some cases the discharge of secretion is accelerated by concentration of muscle in the gland substance, which acts by squeezing the gland tissue. In nearly every case, when the gland cells are stimulated to secrete, there is a concurrent dilatation of the blood-vessels supplying them.

There are conditions when, although the blood-supply is adequate, yet the composition of the blood is lacking in some ingredient essential as a raw material for the production of the particular secretion which the gland produces. When this happens, the gland often overworks itself in a vain

GLANDS



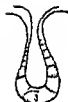
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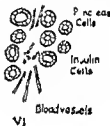
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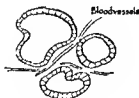
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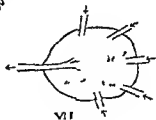
V



VI



VII



VIII

I Simple tubular gland
 II Branched tubular gland
 III Salivary gland
 IV Mixed gland
 V Two types of lymph gland

VI Transverse section of pancreas
 VII Transverse section of thyroid gland
 VIII Lymph gland

attempt to produce its secretion, and thus is a common source of glandular disorder

Lymph glands are more fully described under that name, but a diagram (Fig VIII) is included for comparison with the others

Glas, John (1695-1773), founder (1730) of a Scottish sect, the Glasites or Sandemanians, differing from the Presbyterian Church in their refusal to accept the validity of a national covenant and a National Church. When brought before the Presbytery, Glas maintained that every such Church was anti-Christian.

Glasgow, largest city in Scotland, in



(Courtesy L. M. S. Rly)
Glasgow University

Lanarkshire. Situated on both banks of the Clyde, it has absorbed Govan, Partick, and Pollokshaws. Its proximity to rich seams of coal and ironstone has largely contributed to its development and prosperity. Shipbuilding is the chief industry, and the Clyde is a mass of engineering and shipbuilding yards. Almost all types of vessels are built and launched here. Other industries are huge iron-works, textile factories, chemical works, paper and glass works. There are many distilleries. The harbour and quays extend for 8 m., and can accommodate the largest vessels.

The first St. Mungo's Cathedral was built in 1136 and burnt in 1192. The new crypt was consecrated in 1197. The

elaborate municipal buildings are in George Square, the Art Gallery, one of the finest in Britain outside London, the university founded by Bishop Turnbull, the Agricultural College, the Botanic Gardens, observatory, and hospitals are noteworthy. The water supply is from Loch Katrine and Arklet Water. Much of the dreadful slum area has been cleared and the work is still proceeding. The city is a convenient tourist centre. Government is by a council, under a lord provost, and it sends 15 members to Parliament. Pop (1931) (est.) 1,088,417.

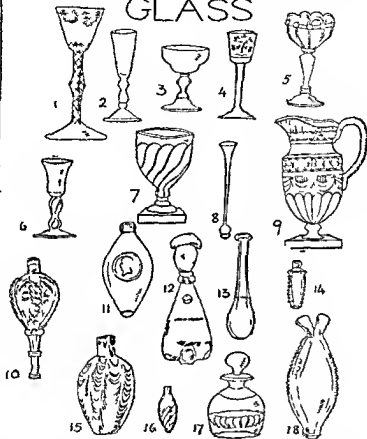
Glass, a hard, brittle, usually transparent substance made by fusing silica, an alkali, and a base. Legend ascribes its invention to the Phoenicians. The general process of manufacture has varied little from ancient Egypt to modern Europe. See GLASS, MANUFACTURE.

The Cairo Museum contains many fine specimens of Dynastic and later glass, including Amphoræ, while designs of animals, birds, etc., were carried out in vari-coloured glass with great delicacy and skill. The British Museum contains an Assyrian glass vase of the 7th cent. B.C.

At the opening of the Christian era, glass-making was highly developed in Rome for table-services, drinking cups, windows, and even as a wall-covering. The Roman glass-blowers used a very wide range of colours, and had many methods of combining these to produce imitations of semi-precious stones and marbles. The Portland Vase in the British Museum is an example of cameo glass, in which several coats of different colours were applied to a base, and the top coating carved away, leaving the design in relief.

Glass-making survived the fall of the Roman Empire, and continued in all European countries. Venetian and Murano glass is world-famous, being unsurpassed for delicacy. Venetian glass was made in colours, with vari-coloured stripes, and with gold introduced to give a sparkling quality. Venetian glass beads are well known.

GLASS



- 1 Knopped-cut stem neglass 150 2 with cameo and 18th century 13 Trick bottle,
 Baluste stem al glass, 150 3. Champagne 14 18th century 14. Flask in form of bellows
 glass, 150 4. Cider glass, 150 5. Sealcoat 15 18th century 15 Bristol flask 16 Seal
 glass, 150 6. Baluste-stem in glass with tears, 17 18th century 17. Toddy bottle 18 Scotch mace
 18 18th century 18. Toddy bottle 19. Scotch mace
 19 18th century 19. Scotch mace
 20 18th century 20. Scotch mace

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GLASS



1 Knopped-c t st wif glass 1750 2 w h ameo early 18th ury 18 Tri k bo tie
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 glass 1750 6 Bal ex-stem glass w h t ara, 1 t 18th ce tury 16 Double flask mod
 1710 7 Engli h t glass goblet 8, 3 d of 1 th enury 17 Luddy 1st Scottish make
 al 1750 9 Logi sh t glass jag 1755 1 18 Bristol snuff bottle.

A various bird fountain 18th century 11. Flask

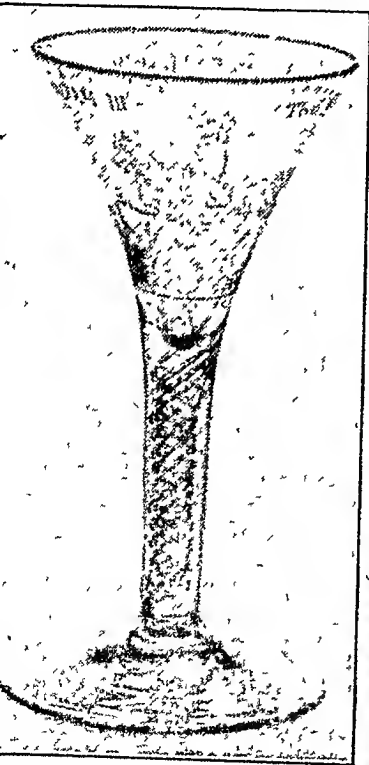
Venice made the first glass mirrors in the late 16th cent. The Venetian technique spread all over Europe, including Germany and England. In Germany enamelled glass became popular in the 16th and 17th centuries.

Bohemian glass, which is well suited to cutting or engraving, was produced from the late 17th cent. Spanish glass dates from Roman times. In the 18th cent a gilding process was perfected, which, with cutting, produces a very pleasing effect.

English and Irish glass-making

suffered severely from excise restriction during the 17th and 18th cents. Waterford glass is especially fine, being of a crystalline brilliancy, and very heavy. Waterford candlesticks are extant, cut in designs which show the beautiful cleanness of the glass. An interesting 18th-cent development in English glass was the very large number of "seditious" drinking-glasses produced either with the Pretender's head engraved on the side, or with a design symbolising the house of Stuart. Modern glass

SPECIMENS OF OLD ENGLISH GLASSWARE



"Williamite" glass engraved with equestrian portrait to "the glorious immortal memory of King Wm III." Tapering stem with spiral twist.



"Privateer" glass enamelled with a ship in white and crimson. Colour 1. 1st story.

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and America, and also as borax (sodium pyroborate), $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$. Sodium and potassium are introduced as carbonate or sulphate, calcium as chalk or lime, lead as red lead, Pb_2O_4 , and barium as natural barium carbonate, BaCO_3 , or witherite, almost any mixture of metallic silicates, and most pure silicates as well, form a glass if fused and then cooled at a reasonable speed. The same is true of the borates and phosphates, many compositions, however, become opaque when cooled, ordinary milk glass is an example of this, the opacity being due to the separation of exceedingly fine particles of some constituent of the glass.

The greatest care has to be taken to mix the ingredients thoroughly. This is performed by means of mixing machines, which are combined with automatic weighing machines, whereby all risk of error in the composition of the mixture is avoided. The melting of glass is conducted either in pots, that is to say, large crucibles, or especially in connection with the manufacture of sheet glass, bottles, and other vessels, by automatic machinery, in large tanks, heated by gas, now practically the only fuel used for firing glass furnaces. These furnaces have been developed to a point at which the highest economy of fuel is obtained, two principal systems being employed for this purpose, called the *regenerative* and the *recuperative*.

The regenerative system was invented by Siemens. It consists of our very large chambers filled with widely separated fire-bricks. Through two of these chambers the gas and air respectively are passed to the furnace, through the other two, the hot spent gases are passed before being sent up the chimney. The bricks in the latter absorb almost all the heat in the gases, and in due course the supply and exhaust of the furnace are interchanged, the air and gas now passing through the heated chamber, where they take up the heat left by the spent gases. This switch over is repeated

at suitable intervals, and in this way the spent gas, which would otherwise carry away a great deal of heat, passes through the chimney at a temperature only sufficient to maintain the draught.

The recuperative system employs what is commonly termed a heat exchanger, which acts continuously. In this system it is usual to heat only the air used for combustion, and not the gas. It consists in passing the spent gases through a large number of passages formed by suitably shaped blocks or tubes, while the air to be heated is passed in the contrary direction around the outside walls of these passages, these walls must be sufficiently thin to allow of a rapid conduction of heat through them. This principle has a large number of technical applications wherever heat (and also cold) needs to be economised. It is illustrated in Fig 1, which shows

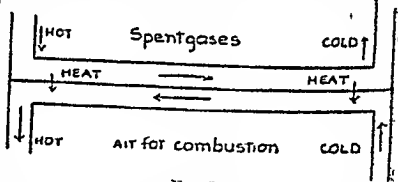


FIG 1

clearly the necessity for the counter-current, since the hotter the air has become in its passage through the apparatus, the hotter must be the supply of heat from the spent gases necessary to warm it further. It is obvious that this system is particularly suitable for oil firing, since in that case, practically no economy would be obtained by heating the fuel. Such furnaces are capable of developing exceedingly high temperatures, and are also used in the ceramic industry, where such temperatures are essential. The manufacture of resistant materials for pots and tanks, capable of standing contact with molten glass at high temperatures, is one of the most difficult and crucial problems in glass-making. Fused silicates exert a

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powerful solvent action upon almost all oxides and solid silicates and since very small quantities of impurities are sufficient to discolour glass the refractories themselves require to consist of almost pure silicates. Blocks of pure silica sand bound together with a minimum of lime (c. 1 per cent) are mainly used in the construction of furnaces. The glass pot has a peculiar and characteristic shape when used for providing glass for blowing (Fig. 1).

The *annealing* (or) of glass is necessary to relieve internal strain caused by rapid cooling and is conducted on a large scale by means of an apparatus called a *Lehr*. This consists of a tunnel through which a belt conveyor passes on which the articles to be annealed are placed.



Fig. 1

The tunnel is heated over a region near the middle to a temperature sufficient to cause the strain in the glass to be relieved without softening it and so causing it to lose its shape. Towards either end of the tunnel the temperature falls by degrees so that an object slowly carried by the belt right through the tunnel is gradually heated up to annealing temperature kept at it for a sufficient time and then slowly cooled. Very thick glass such as is used for table ware particularly if it is to be afterwards cut or engraved is still annealed in a kiln that is an oven in which the glass is slowly heated to annealing temperature and as slowly cooled. Optical glass in which freedom from strain is peculiarly essential is always annealed in the kiln. Large telescope objectives are annealed in an electrical kiln the cooling period occupying many weeks (see Optics).

To test annealed glass to ensure that strain no longer exists polarized light is used. The simplest method is to place a sheet of black glass near a

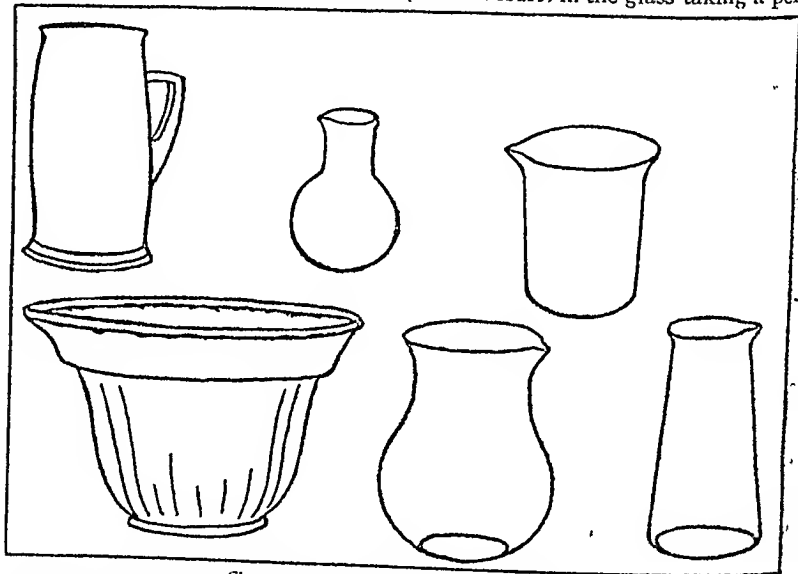
window the glass object is examined by light from the sky reflected from the black glass and a Nicol prism (see Optics) is held to the eye and turned with the fingers. If strain exists in the glass brilliant colours are seen in it which change as the prism is turned. This is the usual method of examining all work in well-conducted glass blowing workshops.

Originally almost all manufacture of glass articles was conducted by blowing from the pot. In this process the workman takes a long straight iron pipe which may be 6 ft in length and $\frac{1}{2}$ in in diameter and gathers glass upon the end of it by repeatedly dipping it into the molten mass having first heated it to the correct temperature so that the glass will stick to it. It is then allowed to fall by its own weight into a pear shape. These operations are performed by the gatherer. Another workman the blower then takes the pipe and rolls the glass upon a large flat stone called a *marl*. This shapes the glass when accompanied by a certain amount of blowing into a hollow thick bulb called a *parison*. The blower then introduces this into a mould usually of wood which he opens by means of a pedal closing it again and blowing at the same time rotating the pipe until the vessel is sufficiently solid to be removed from the mould. The blower then hands the pipe to the *utter off* who applies water near the mouth of the pipe which causes the hot glass to crack there thus detaching the vessel from the pipe. It is then immediately passed to the annealing furnace since if allowed to cool it would almost certainly crack. This is the usual method by which glass bottles and other vessels are made by hand the output being about 1 gross of 1 pint bottles per hour for 5 men. Large vessels such as carboys the volume of which being measured in gallons prevents their being blown by the breath alone are made by the blower taking water into his mouth and injecting it into the vessel where it at

once becomes steam and aids the blower in producing the pressure. Glass-blowing by hand, even in this simplest form, is a matter requiring long training, while the skill needed for blowing elaborate and artistic designs, such as are produced in Venice and other places, is almost miraculous.

Such a material, which instantly loses its shape by its own weight when not handled properly, requires for its manipulation very few tools, but a

engraver's wheel. The famous Portland Vase is an example of this technique. Bottle making by machinery is described in the article BOTTLE. Similar machines are used for making electric lamps, bulbs, and other articles of thin blown glass, but here the vessels require to be rotated during blowing in a perfectly smooth mould. This consists of a cast-iron mould, coated with a carbonaceous paste, which results in the glass taking a per-



Characteristic shapes obtained by blowing

great deal of skill. Effects such as flutes and spiral decorations are made by sheer manipulative skill, using only the simplest apparatus. The handles of jugs and the stems of wine-glasses are formed freely by manipulation of the glass and not by any process of moulding. What is known as *flashing* is another method of decoration; it consists in coating a vessel of one kind of glass, e.g. colourless, with another kind such as a coloured or opaque glass, which may afterwards be cut away into patterns by means of the

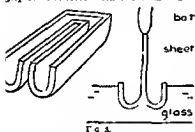
perfectly smooth surface. Such machines are called paste mould machines.

Sheet glass is of two kinds, *window glass* and *plate glass*. The first possesses the surface with which it cooled from the molten state, the second is given a much flatter surface by grinding and polishing.

The modern method of making *window glass* consists in drawing it from a large tank of molten glass. What is called a *bait* is made to touch the surface of the glass, which sticks to it along a straightedge. The bait is then

pulled at a steady rate vertically upwards and if the glass is at the right temperature it is drawn up in the form of a thin sheet which cools solid as it goes. Precautions have to be taken to prevent the sheet from becoming narrower and narrower as the bath rises. In the *Fourcault process* this is accomplished by drawing the glass from a trough with a long slit floating on the surface of the glass. The trough would fill with molten glass but for the fact that the glass is continually being taken away, and hence the glass is fed to the sheet at a controlled velocity (Fig. 3).

In the *Colburn process* the sheet is taken direct from the surface of the bath and is kept stretched to its full width by water-cooled rollers which grip it as it rises from the bath. This



process is the most successful and is being adopted all over the world.

Plate glass is usually made by pouring molten glass upon a large iron table and rolling it to a uniform thickness. It is then annealed, the surface thus produced being of course very irregular but such glass is largely used for glazing, where mechanical strength is necessary. Figure 4 plate glass has an impression of some kind moulded on the surface by rollers thus giving it a more agreeable appearance. A very important development consists in embedding wire netting in such glass which prevents the glass from falling to pieces when cracked by a blow or by heat. The wire used is an alloy of iron and nickel having the same coefficient of expansion as glass.

Polished plate is made from the

highest grade of glass which after being rolled into sheet and annealed is ground flat and polished by machinery. A continual increase in the size of sheet manufactured has taken place and 400 sq. ft. is now common, the weight of such a plate being c. 3000 lb. All but the very cheapest mirrors are made from plate glass since window glass never being perfectly flat gives a distorted image. They are silenced by flooding the surface with an ammoniacal solution of silver nitrate to which a reducing agent such as Rochelle salt or grape sugar has been added.

Tubing is made by the very simple process of forming a suitable cylindrical parison as already described which may then be re-heated by attaching a rod at the opposite end of the blow pipe this being held by a second workman. The two then walk rapidly away from one another on a wooden track whereby the parison is drawn out into the tube the size of which depends upon the original size of the parison, its temperature and the rate at which the two men walk. The glass tube thus made is called *Cane*. The glass rod is made in the same manner. Recently a very ingenious machine the *Danvers* blow-drawing machine has been constructed which forms from a steadily flowing band of molten glass a tube which is pulled away as formed by means of two endless chains passing over pulleys which grip the tube. This will make tubing 1/2 in. in diameter at the rate of 140 ft. per minute the product being much more uniform in diameter than hand-drawn tubing.

Optical glass of the best quality requires a standard of manufacture far beyond that necessary for other purposes. It is essential that it should not only be free from visible flaws (stones) and the fine air bubbles known as *striae* but also from what are called *striae* which appear as a slight distortion of the image through the glass and are due to slight differences in composition resulting from imperfect mixing.

A very specialised technique is em-

ployed in melting optical glass to remove air bubbles (*seed*), and to render the glass perfectly homogeneous, since, however carefully the ingredients are mixed before melting, they will not fuse at the same temperature, and will, therefore, tend to separate. The glass, when thoroughly molten, is therefore stirred by means of a slightly tapering fire-clay cylinder, fixed to a water-cooled iron core, which is driven by a machine. The exact track of the stirrer and the speed at which it is moved are matters of the utmost importance, and have been determined by long and costly experience.

The pot of glass, after stirring is completed, is allowed to stand and cool until solid, and the glass is then broken into pieces, which are examined carefully for defects. By carefully regulating the cooling of the glass, it is possible to cause it to crack of its own accord in a fairly regular manner, whereby a great deal of waste is prevented. With the very finest work, the glass is cut into slabs, which are polished on two faces and annealed, the best class of lenses and prisms being made from selected pieces. For nearly all general good-class work, the irregular lumps of glass resulting from breaking up the mass are put into refractory dishes in a furnace, and heated until they just melt and take a regular shape, when they are annealed and examined optically. For the cheapest class of work, glass is taken from the tank and pressed into lens shapes in moulds. Optical glass is cut by a thin soft iron or bronze wheel revolving at a speed of *c* 350 revolutions per minute, and then armed with diamond dust (*bois*). It is wetted and then used. Grinding is performed by embedding the glass in pitch and grinding it with emery, fed to a cast-iron disc of the curvature desired. It

is polished by means of different grades

Glastonbury, a market town (4515) in Somerset, famous for its Benedictine abbey. According to legend St Joseph of Arimathea deposited the Holy Grail in the church. The settlement founded *c* A.D. 166. Larger



[Courtesy of]
Glastonbury Abbey

were built round the *Vetus* by St David (530), by the King of the West Saxons (708), and by St Dunstons (*q v*), who made Glastonbury a centre of learning. King Alfred and Queen Guinevere are said to be buried here. In 1184 the church, together with the *Ecclesia*, was burned. The ruins are those of the church of its place (1186-1303). The church was suppressed in 1539. The "bury Thorn," which flowers on May day, is said to have sprung from the staff of Joseph of Arimathea. Glastonbury Tor (550 ft.) commands a fine view.

